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British Orthopædic Association

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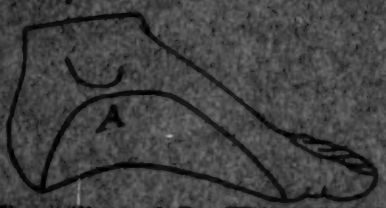

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VOL. IV, No. 3 JULY, 1922 Old Series: Vol. XX, No. 3

The Journal of Bone & Joint Surgery

THE SPECIALIST IN SURGERY AND HIS VIEWPOINT.

BY NATHANIEL ALLISON, M.D., ST. LOUIS, MISSOURI.

Professor of Clinical Orthopaedic Surgery, Washington University School of Medicine.

PRESIDENTIAL ADDRESS BEFORE THE AMERICAN ORTHOPEDIC ASSOCIATION, WASHINGTON, D. C., MAY 1, 1922.

FELLOWS of the American Orthopedic Association, Guests of the Association, Ladies and Gentlemen: We are gathered together to hold the thirty-sixth annual meeting of the American Orthopedic Association. As your President, it is my privilege to bid you welcome. As your President, it is my duty to deliver before you the annual address. The thirty-five presidents of our Association who have fulfilled this yearly obligation before me have left a series of documents which may serve as an index of the moods, the hopes, and the anxieties of this honorable body. Therein lies a record of our aims, and of our success in attainment. Through these pages one may glimpse the problems of the infancy, the youth, and the early manhood of our special surgical work. One may observe the progress of this work, too, as it has kept pace with the growth of modern surgery. The impression is unavoidable that our

Association has had an illustrious career; that it has reached a vigorous maturity; and that the future still holds much that must be solved. It is this last thought that gives us pause. The past we know full well; admittedly we are chiefly concerned with our immediate present, but we must engage our thoughts with a vision of the future. In the nature of things youth is followed by maturity, and maturity by the gradual sclerosing processes that presage old age. Our strong young manhood has been gained, as the records show, by the evolution of a spiritual ideal associated with a practical purpose, and through this combination our particular type of surgery has become established as one of the departments of modern surgery; one that demands not only a special training, but also a special fitness; one also that includes the crystallization of ideas, that once were but dreams, into practical and well-established facts. But along with maturity has come a certain dogmatism and belief in an established order and a tangible creed. We are inclined to be ruthless with those who presume to question the truth of our beliefs and the validity of some of our creedal tenets. This mental attitude is no other than the normal state which comes with the gathering of experience and knowledge, and it signifies maturity. The thoughts of maturity may be longer thoughts than those of youth. It is with the hope that our Association may long continue to contain elements of elasticity and buoyancy, that we may forever stay the first stages of sclerosis, that I venture to address you as your thirty-sixth president. I have chosen as the subject of my address the following: "The Surgical Specialist and His Point of View."

This subject has become dear to my heart for I realize that to each and every one who considers himself a specialist in surgery there must come moments when he is inclined to question his whereabouts, both in their relationship to the progress of his own specialty and to the progress of surgery as a science.

As our specialty, that of orthopædic surgery, has progressed along the road of development it has accumulated about it certain tendencies that have grown to the size of creeds and fixed beliefs. I do not hold that our own specialty is peculiar in this matter. I believe it to be one of the evidences of growth and progress that adventitious issues tend to grow up like tares which may choke our better aspirations.

Of these, perhaps the greatest is an increasing evidence of self-satisfaction with our accomplishments; and how could this be otherwise when one looks back across the span of years and notes the facility with which things are now done that once were either difficult or im-

possible? On the other hand, it seems wise to point out that our fathers — the men who founded this Association — were concerned with the treatment of the same conditions that we are now called upon to care for surgically. These men who banded together to form this Association were men, in most instances, of extraordinary attainment. They felt it necessary to join together because of the mutual improvement and satisfaction gained by discussing their difficulties. We are inclined to assume an attitude of self-satisfaction when we look back upon their methods and their results; but are we entitled to this self-admiration? I may mention that the clinical conditions which gave the founders of this Association their *raison d'être* included, among others, lateral curvature of the spine, congenital dislocation of the hip, the infectious arthritides, and the residual paralyses that follow anterior poliomyelitis. One may ask how far we of the present have traveled toward the solution of these problems, and where do we stand relative to the past generation as far as gaining a definite solution is concerned? One may point out that we are entrusted with this solution both by our colleagues in medicine and by the laity. Indeed, it is our chief reason for existence today as surgical specialists, and much of our future use in medicine depends upon the way in which we work to alleviate these and similar conditions which human flesh is heir to. If we have not the scientific imagination and the inventiveness to do this, there will surely arise some one else who will. My own self-satisfaction suffers much when I consider these facts, and I feel that much good may come to the soul of our organization by an occasional self-examination of this nature, ungracious as it may seem to mention it at our annual gathering.

Another of our tendencies is the expressed desire to fence about our special field in surgery and to indicate that he who wanders beyond its barriers is out of bounds. Perhaps it were better to think that there is nothing on the whole range of medicine that is branded as belonging to any one or to any group, and that only through strong competitive struggle are men developed who look upon scientific attainment in the proper way. If our specialty in surgery is to become routinized and compressed within narrow boundaries, then will our specialist be a narrow man and our Association will no longer be mature, but will be old and settled. It is possible to cite many examples of the effect that this narrow specialization and these limiting boundaries have had upon those engaged in other special fields in medicine and surgery.

Along this line of thought also there has come up recently a new

tendency—one that may be termed that of smug standardization. This notion got its start from our participation in the last war. It was necessary during our military effort to use large groups of untrained men for special duties, and certain rule-of-thumb methods were devised to take care of emergencies that must be met. In consequence, standard methods of doing things in the quickest and most effective way were adopted. It was necessary to plan these methods so that they would be "fool-proof." Perhaps there is nothing worse that could happen to our special type of surgery than the growth of a limiting idea. It is not for us to dim the spark of the investigative spirit, to set it, to splint it, or to hold it under control. Rather let us seek to build up a spirit of non-conformity, using non-conformity in its better sense. Surely we do not desire the perpetuation of our faults. If our young men are to be no better than we are, if our future is to be no broader than our present, then our specialty is at once old and dead. Perhaps this outcropping of a desire for standardized methods is the first symptom of the passage of our specialty beyond the age of maturity.

To those of us who hold dear the position of our Association in surgery, there comes another thought which is not new, but which I dare not pass over without mention. We are constantly tending toward a belief that we may allow men to become surgical specialists without first being trained as surgeons, and with this also runs hand in hand the idea that a special part of the surgical field may be greater than the field of surgery itself. President Vincent recently said that it is the specialist's best attribute that he is inclined to believe that all the world rotates about his specialty. I, too, believe in this enthusiasm, but I would demand that the background for it be secure. Surely we have grown old enough and important enough for our work to stand upon its own merits; surely we must believe that much of this security is dependent primarily upon the ability to do surgical work as well-trained surgeons and not as narrow specialists.

Perhaps orthopaedic surgery has in this regard reached a parting of the ways. One path leads to narrow specialization with smug standards and lack of broad vision. It is a simple matter to train men for this type of surgical effort; there need only be fulfilled a set of definite requirements and the men trained will soon be capable of carrying on to their own satisfaction and the satisfaction of their fellows. These men will be alike — an established type. The other path leads to what seems to be a future of greater achievement. Men who enter this path must be broadly trained. The whole of surgery must be theirs. They

shall have the desire to add to their general qualifications that of a special interest and a special opportunity which will utilize their special fitness. They shall not be men alike in mind and outlook. For such a group as this the future will hold no limitations and our Association, manned by such a personnel, will continue to advance with the procession of modern surgery; not following, but leading.

So much am I convinced that we should follow this broader path, that I would urge the serious consideration of attracting men to our Association and including in our membership those who have an especial interest in the surgery of the extremities and spinal column, but who are frankly not to be considered as surgical specialists. Our Association needs this transfusion of new blood. This type of surgeon needs the encouragement offered by such a body as our Association. Some one has divided all surgeons into two classes — carpenter and plumber surgeons. Our Association should represent the best interests of the carpenter surgeons. Surely we have not come thus far along the path of progress to find ourselves halting in our efforts at future achievement. Let it be set down as most hopeful that our Association has reached a period of security wherein it can justly consider its past, rightly estimate its present status, and hopefully dream of what it may accomplish. I firmly believe that grandeur is so nigh our dust that the youth of our Association will hear more vividly the whisper of idealism and that we shall always acclaim a broader and braver viewpoint.

CHRONIC ARTHRITIS.

BY LORING T. SWAIM, M.D., BOSTON.

ARTHRITIS has been divided into three groups by Goldthwait, Painter, and Osgood[1]: the infectious, the atrophic, and the hypertrophic; by Nichols and Richardson[2] into two: the proliferative and the degenerative; and by the English[3] into rheumatoid and osteo arthritis. This has been, and is generally, accepted today. Of late, the infectious and atrophic cases have been grouped as one disease. The reason for this paper is that from the clinical, pathological, and x-ray study of these groups certain definite differences can be noted, and because of these differences the infectious and atrophic would seem to be entirely different entities, varying again from the hypertrophic. The museum specimens of these groups are not at all alike, the x-ray pictures are quite different, and the clinical onset, symptoms, and signs are also very unlike each other. A clearer conception of arthritis is being reached, but there is still much dispute. We are in the clinical study stage in regard to these diseases. We do not know that these groups are caused by the same agents. In fact, the clinical symptoms and x-rays all point to a different cause in each type, or at least to a very different reaction in different persons. Recently, much attention has been called to the study of arthritis by the work of Dr. Pemberton,[4] and the recent communications of Dr. Ely[5] have aroused interest, and more writings on chronic arthritis are appearing. It would greatly facilitate the future study of these baffling diseases if the kind of arthritis were specified in connection with the observations, x-rays, clinical etiology, and treatment. This may, in time, lead us to the causes, prognoses, and correct treatment of the chronic arthritides. To bring out this difference in type this paper has been written. Following is a brief review of our knowledge of the groups of arthritis from a clinical standpoint.

INFECTIOUS ARTHRITIS.

Etiology. Infectious arthritis is the result of the spread of some focus of infection, usually from some point in the alimentary canal or the genito-urinary tract, more rarely from some abscess outside this

mucous membrane system. Starting from the mouth, the chief localities for chronic infection are the teeth roots, tonsils, sinuses, gall-bladder, appendix, and in our experience, the cecum and large intestine are by far the most common sources of absorption of bacterial toxins or the results of their action on food residue. From the genito-urinary tract we have gonorrheal infections of the prostate, pyelitis, and infection of the seminal vesicles, all of which may produce an infectious arthritis. Endometritus, inflammation of the Fallopian tubes, may cause arthritis, but rarely will vaginitis produce infection.[6] These infections vary in intensity from the suppurative to the mild toxic symptoms of stiffness only. This is dependent on the virulence of the bacteria, the general resistance at the time of infection, and the number of joints involved.

The onset of joint symptoms may occur shortly after the acute local infection, or if the general resistance is good, a low-grade focal infection may be latent, yet can produce joint symptoms years later after some severe illness or if the body vitality is lowered by exposure, fatigue, or malnutrition. Age and sex seem to play no part in the incidence of the disease. It is seen in childhood as Still's disease, or may reappear later after an acute rheumatic fever. It is possibly more frequent in damp climates, where all throat and sinus troubles are prevalent or where exposure to chills is always an important predisposing factor.

Clinically, the history is that the joint or joints swell, become painful, tender, and hot, a few weeks after an acute infection, such as tonsillitis or a cold, for example. The joints show the typical signs of infection, heat, swelling, and tenderness, the capsule is distended with fluid, joint motion is painful, the temperature is elevated more or less, depending on the extent of the involvement and the acuteness of the infection. Again, the toxic or infectious symptoms in the joint may be very slight and intermittent over a long period, showing chiefly in periarticular soreness, stiffness, and slight chronic thickening. In such a case the chart shows a slightly elevated temperature over a considerable period. There are marked fluctuations. The blood shows secondary anemia and, as Pemberton has shown, a low sugar tolerance, as manifested by high blood sugar.[7]

There is no particular joint distribution in infectious arthritis. Any joint is susceptible, the disease may be monarticular or periarticular, and the joints involved may vary from week to week in mild cases. The history of the month before the first joint symptom is of great

FIG. 1.—Infectious Arthritis. The left metacarpophalangeal joint of the thumb has been swollen, hot and painful for four years. Recently the first metacarpophalangeal joint has been swollen. The capsule is distended. There is no bone atrophy, no cartilage erosions, no bone changes. The infection is periarticular.

importance, as it frequently points to the area to be investigated for a focus. Often, however, there is no evidence to work with and the only course open is a painstaking search. After a supposed focus has been found and removed, the infection has undoubtedly produced more foci, and the only procedure is to increase the general resistance to the unknown focus. The end-results are a thickened capsule, adhesions, with fibrous ankylosis, dependent on the acuteness of the infection.[8] In mild cases frequently there are no signs of damage except periarticular thickening and no symptoms except stiffness during barometric changes.

In most instances it has been impossible to demonstrate the existence of bacteria in the affected joints,[9] but they have been located in the deep layers of the synovial membrane. Pathologically, we find fibrous and synovial capsular adhesions. In some cases the joint cavity is ob-

literated, there is marked hyperemia, and marked evidence of chronic inflammation in the fat tissue about the joint. The joint fluid varies from an exudate to pus. The cartilage may show inflammatory erosions. There are no bone changes found.[10] The x-ray findings are those to be expected from the above description. There is periarticular capsular thickening, fluid increase with distention of the capsule, joint cloudiness, but no bone changes except those of slight general atrophy from disuse. (Fig. 1 shows a hand, four years after first joint symptoms. This is believed by the writer to be a typical infectious arthritic case.)

ATROPHIC OR PROLIFERATIVE ARTHRITIS.

The second type of arthritis is the proliferative of Nichols, or the atrophic of Goldthwait. In many respects the name "atrophic" seems better from a clinical standpoint, because the x-rays usually show clearly atrophy of the bone structures, whereas the proliferative refers to the soft tissue changes, which are not shown by x-ray and are not, therefore, demonstrable in a living patient. This joint disease seems to have certain features peculiarly its own, making it a clinical entity. Whether it is due to infection we do not as yet know. The present clinical evidence and its characteristics are against this view. In our experience atrophic arthritis is atrophic from the start, and remains so. Infectious arthritis is infectious from the start, and does not develop atrophic changes.

The etiological factors are these: atrophic arthritis is found everywhere. It is a disease of early middle life, rarely occurring before twenty, and is by far more common in women than in men. It appears to be more common than the other types, and from our experience is increasing in proportion to the others. A notable fact about this disease is that it is almost exclusively found in the moderately slender anatomic type,[11] the so-called visceroptotic person, characterized by light bones, loose abdominal organs, short small intestines. They are subject to nervousness and malnutrition, and under nervous strain show decided evidences of instability, both mental and physical. It is not more common among the poor than the well-to-do. It is associated with nervous and physical strain, more often the former. Nervous shock is a predisposing factor. It is usually polyarticular and involves the smaller joints.

Clinically, atrophic arthritis is slow in its onset. The first symptom

in many cases in our experience is a vasomotor phenomenon, occurring in the fingers. One or more fingers become pale, slightly numb, and a little painful, or rather "tight." This local vasomotor contraction may be momentary or last for some time. It is not related to temperature, occurring on hot summer days as well as in the winter, but it is more common during chilly, damp, or foggy weather. It is not infrequent at night. This phenomenon may be of frequent occurrence or may occur only during fatigue or strain. It has been observed six months before the x-rays showed any bone changes. Its significance is not known, and whether it is a factor producing endarteritic changes found in this disease cannot be stated. Its causes are probably nervous. It is in some cases a very transient symptom and is frequently overlooked by the patient. Attention was called to this before. Shock is a frequent point in the history; excessive worry and unhappiness, fear, and nervous strain often precede the first symptoms.

Characteristic general symptoms are depression, mild fear, instability. There is malnutrition of the muscles and skin, as well as atrophy of the bone. Chronic fatigue is common. Pain is not an early symptom, and it may be lacking for some time after the joint enlargement appears. The temperature instead of being above normal is usually subnormal. The blood pressure is commonly low. The pulse is frequently rapid and small. The appetite is poor and the weight is subnormal. An almost constant clinical feature is the acid saliva. Blue litmus paper is turned red. The tongue has a clean, red, wet appearance. The gums are often soft, spongy, and bleed easily. They show marked retraction and are sore. They strongly resemble the gums found in mild scurvy cases, where food deficiency is a factor. Quite frequently no focal infection can be demonstrated, and the results of the removal of teeth and tonsils have been disappointing in the atrophic cases.

Clinically, the small joints early show widening of the joint with a soft tissue swelling. There is abnormal mobility of the joint laterally. In the hand the finger is shortened by the destruction of the underlying bone and cartilage until all resemblance to a joint may be lost. (Fig. 2.) The dry crepitus felt in such a joint means cartilage destruction and loss of synovial fluid. Bony ankylosis is the end-result. Deformity is the rule in atrophic arthritis. The disease is progressive with remissions, unless proper means to offset its course are taken, or nature asserts itself.

The visceral studies in atrophic arthritis are in accordance with the

FIG. 2.—Atrophic Arthritis. Late stage arrested. General bone rarefaction, especially at joints, in carpus; complete destruction of metacarpophalangeal joints, bony ankylosis of some of the phalangeal joints. Some of the phalanges have become bent. There are no hypertrophic spurs after ten years.

anatomic type of the patient in whom this arthritis is most commonly found, that is, the visceroptotic type with the tubular, low stomach, short small intestines, and the low, loosely attached cecum. There is quite often cecal stasis, with a tendency to spastic constipation. With this type of anatomy one finds great variability of the gastric and intestinal function, both motor and secretory. Colitis is common in this anatomic type and is frequently found in atrophic arthritis. There is fermentation, gas, and quite often foul stools with considerable undigested food particles present. Colonic irrigation, or castor oil, or a radical change in diet will many times give relief from joint soreness. Menstruation often has a decided effect on the joint symptoms as well as on the whole

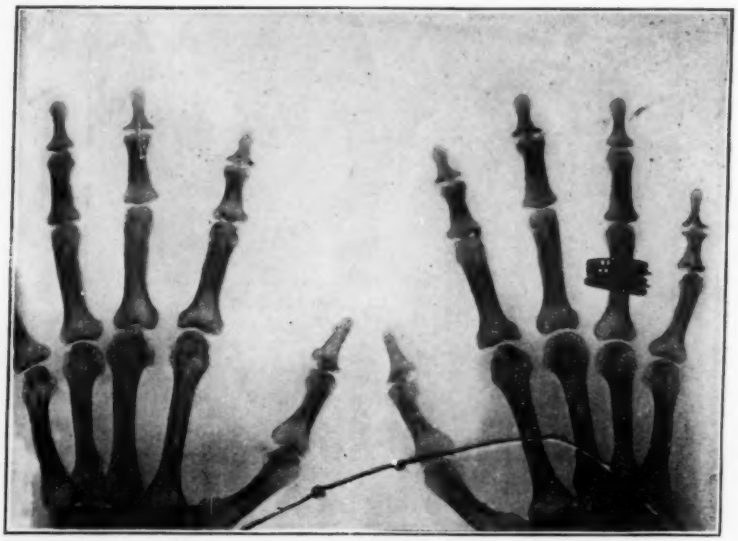

FIG. 3.—Atrophic Arthritis. Two years old. 1916. Note the general bone atrophy, especially about all the joints. Some still show cartilage with atrophy below it; in others it is gone; mushrooming has occurred at the terminal phalanges. There are no spurs being produced. The bones are almost porous.

physical condition. The joints are apt to be swollen and more painful at this time, and are better between periods. There is more mental depression.

Pregnancy usually improves the atrophic arthritic during the gestation, but after delivery the joints are frequently worse and show decided increase of the bone atrophy. A possible explanation of this is that during pregnancy the demand for bone salts is increased. In the atrophic case these salts are at a premium, and since the rule is that the child shall not lack, the result should show a greater bone atrophy after pregnancy. This is often the case. There is, however, another explanation. It is that during the pregnancy the enlarged uterus gives such perfect support to the low viscera that metabolism is better than at any other time. After delivery, this sudden withdrawal of the support correspondingly makes the bone physiology worse. Both may be factors. In a number of cases atrophic arthritis has occurred after pregnancy or miscarriage.

Nervous symptoms are more frequent in the atrophic patients. They are normally high-strung, as is common in the slender anatomic type,

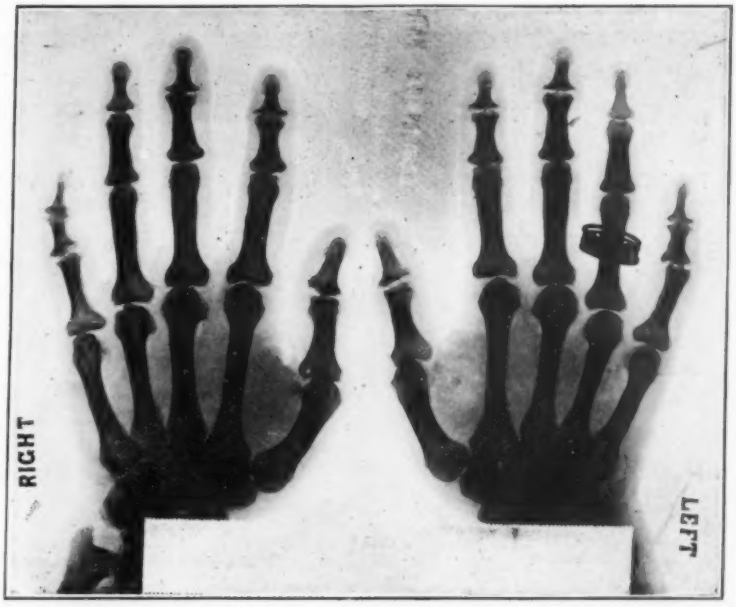

FIG. 4.—Same case as Fig. 3, one year later, 1917. Note the changes in the terminal phalangeal joints. They have become atrophied away, and the fingers have shortened and the mushrooming has increased. Note especially the changes in the second finger on right hand and little finger on left.

especially so in women. They frequently have undergone some severe nervous strain prior to their arthritis and they show more depression and fear than either the infectious or hypertrophic arthritics. This nervous tendency may have its effect through the glandular system, as Cannon[12] has clearly demonstrated the effect of fear, shock, etc., on the suprarenals. Skin changes in the later stages are common. The skin is also rather non-elastic, staying wrinkled when pinched up. Later the skin of the hands becomes smooth, shiny, and polished. The finger nails show deformity, probably due to interference with the matrix of the nail, as a result of bone changes or to general atrophic changes noted in all parts of the body.

An interesting condition is frequently found in the mucous membranes of the nose and throat. They show atrophic rhinitis. The atrophic arthritics often become fat after the active stage is passed.

From the foregoing observations it would seem a reasonable deduction that these atrophic arthritics have a decided physiological disturbance with insufficient stability of their metabolic processes to affect near-

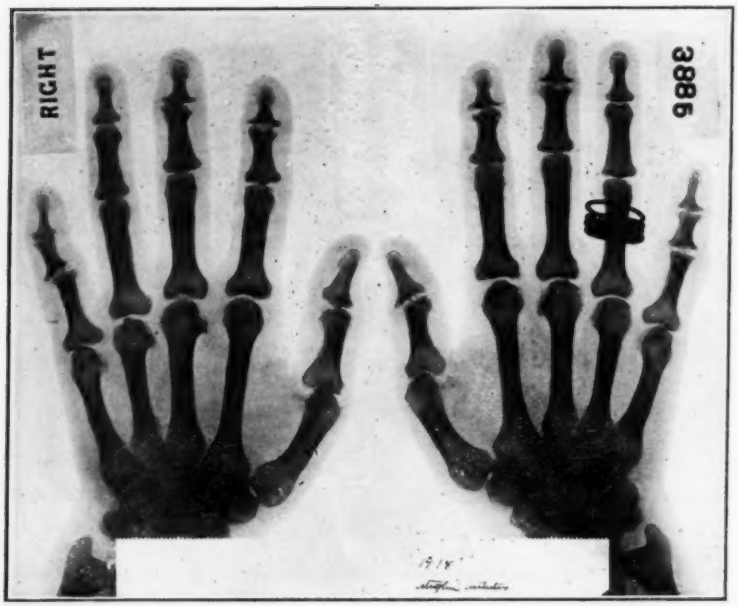

FIG. 5.—Atrophic Arthritis. Same case, one year later, 1918. Note more bone atrophy and absorption, 2nd finger right, little finger left, and left thumb. Ankylosis of terminal joint of the little finger, right. Symptomatically, the disease had remained quiet. The x-rays showed destruction, but less bone rarefaction.

ly all parts of the body as well as the joints. The picture is one of malnutrition of the bones, muscles, skin, mucous membranes, and nervous system, with a low blood pressure and vasomotor instability. It resembles a nutritional disease, the joint disease being only part of the picture.

The pathology of these joints is interesting, as described by Goldthwait, Painter, and Osgood.[13]

The synovial membrane becomes congested with villous formation and excess of blood-vessels. The fat is increased. The fibrous tissue gradually increases with more fat. Endarteritic changes occur and there is less blood supply. Finally the tissue resembles that of a scar. These changes are very slow. The cartilage loses its glistening healthy aspect and becomes duller, striated, and thinned out, with finally non-inflammatory erosions. The cartilage is replaced gradually by fibrous tissue. The bone is eroded, as is shown clearly in the serial x-rays. (Figs. 3, 4, 5.) Bony ankylosis is common. A note in this connection is inter-

esting—the bone atrophy frequently seen at the end of an arteriosclerotic artery. No bacteria have ever been demonstrated about these joints. The process seems to start in the bone and destroy the cartilage from below the joint, as opposed to infectious arthritis, which begins in the joint.

The roentgenological examination shows apparent widening of the joint, suggesting a mushrooming out of the soft atrophic bone. The digit is shortened or deformed by the bone destruction. After the erosion has proceeded far enough to bring raw bone surfaces together, bony ankylosis occurs. This bone destruction can be followed by serial x-ray plates and has been observed without any inflammatory reactions present on examination of the joint. There is often no pain during the destructive progress of the disease, as shown by x-rays. Serial plates are the only guide to the therapeutic control of the disease, as these alone show the actual bone changes taking place.

HYPERTROPHIC OR DEGENERATIVE ARTHRITIS.

The third type of arthritis is the hypertrophic, or degenerative.

Etiology. It occurs in older people, as a rule beyond middle age, or in those who show signs of premature old age. Hypertrophic changes are associated with trauma of the joints and are often monarticular, as opposed to atrophic, which is rarely monarticular. It is most frequent in the knees, fingers, hips, spine, shoulders, and feet, depending often on the occupation. On the other hand, it seems quite probable that trauma decides the locality, and a diathesis is responsible for the bone changes. Hypertrophic bone changes are an accompaniment of old age in the heavy anatomic types, being frequently found in the gnarled fingers and stiff back of these people.[11] It is rarely found in the slender type of back. It is more common in men than in women, probably due to a more exposed life of strain and trauma.

Clinically, it is as a rule painless in its onset, the bone changes being found quite well marked in joints which have never given any symptoms. It is frequently a cause of joint pain through mechanical irritation and trauma of the spurs. There are no vasomotor phenomena. There are rarely any acute local symptoms such as heat, redness, or tenderness. The temperature is not affected. The patients are of the heavy anatomic type: thick, heavy bones, large, high stomachs, long small intestines, and the big caliber large intestines. This is the sluggish digestive type, with the flaccid constipation and bulky stool. The acquired

sag of the heavy stomach and intestines is frequently found associated with hypertrophic arthritis. As is common in the heavy anatomic type, arteriosclerosis and high blood pressure are often present. In this type one finds the tendency to sluggishness, over-weight, slow pulse, many of the signs of hypothyroidism, such as dry skin and hair, brittle finger nails, with constipation of the flaccid variety.

The traumatic hypertrophic joint is usually monarticular, such as the hip, the pain being due to the original trauma, later kept up by the resultant hypertrophic spurs. Trauma does not necessarily mean acute trauma, but may be the result of long-continued strain of an improperly used joint. This is frequently found in the knees and the lumbar spine, the changes having been the attempt of the body to prevent strain. One of the chief causes of these chronic strains is faulty body mechanics. Again, in old people the bone changes occur slowly, painlessly, and without any inflammatory reaction at all. Frequently the physician is never consulted in such cases. Again, cases with very extensive hypertrophic bone changes come to the physician for other causes and the arthritis is found in the process of examination.

This all goes to show that hypertrophic arthritis is quite different from the other two types, and is a slow, painless process which is so gradual that often no symptoms are noticed by the patient locally or constitutionally.

The hypertrophic arthritis is extremely rare in the slender anatomic type, as compared with the frequency with which it is found in the heavy type.

In a general examination these patients show certain signs of hypothyroidism. They tend to gain weight, the hair and skin are dry, the finger nails brittle, and most of the bone changes unassociated with trauma occur after the menopause, when the appearance of general physiologic retardation is much more rapid and noticeable. Apparently all the body chemistry is at a very low ebb. The pulse is slow and full, the blood pressure increased, the digestive tract is slow, muscular activity is decreased, the weight is gained easily, and the mind is less active. Basal metabolism tests are below normal.

The Pathology. The synovial changes are slight, the joint cavity is usually normal in appearance except in spots of hypertrophic cartilage and villous formation. There is no increase in the vascularity and rarely an excess of fluid. The cartilage is irregularly hypertrophied, especially at the joint margin, and is easily felt on palpation of a knee, for example.[14] The cartilage is not striated as in atrophic arthritis. The

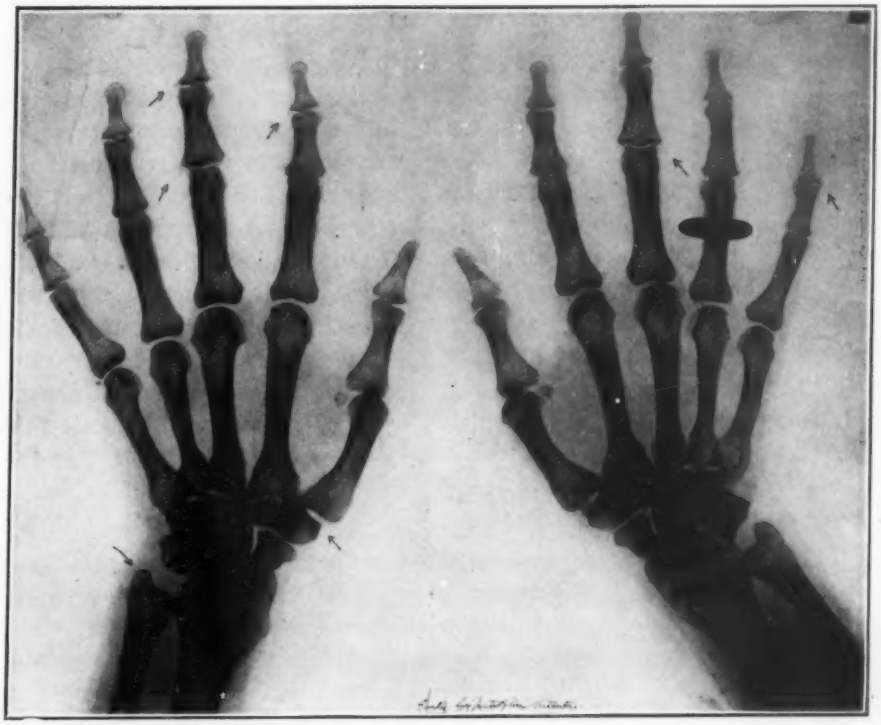

FIG. 6.—Hypertrophic Arthritis. Note the bone spurs on the terminal phalanges following the line of the capsule. No atrophy of the phalanges or carpus as seen in Fig. 3.

microscopic examination of the cartilage is described as overgrown with rapidly growing cells, and the synovial membranes have more fat cells than normal. The erosions found are not inflammatory, but have the appearance of mechanical erosions, differing in this respect from the infectious type and also from the atrophic erosions. The x-rays show no atrophic spots in the bone substance. There is almost no soft tissue swelling. The growth of the spurs is from the cartilage margins as a rule. The whole bone is as solid as normal, or even a little more so. (Fig 6.)

From the foregoing brief review of the types of arthritis it would seem that they differ from each other quite markedly in many important ways. If infection is the cause of all these types, then the kind of arthritis produced is dependent on the tendencies inherent in the individual victim. In other words, as we have previously attempted to show, the atrophic arthritis will occur in those patients having the predominant

characteristics of the slender anatomic type. Hypertrophic arthritis will occur in those who have the heavy anatomic characteristics chiefly marked.[11]

As has been repeatedly shown, the slender anatomic type has viscera which pass food on rapidly, especially in the small intestines, where the chief part of food absorption takes place. In this type there is not only the rapid peristalsis to be considered when functionally upset, but the small intestine is actually shorter in length, making nutrition a difficult matter at best, but more so when any functional derangement is added. Again, this type tends toward cecal stasis, due to the loose redundant cecum and free hepatic flexor almost constantly present, the tip of the cecum often being over the brim of the true pelvis out of reach from the front, as is seen in x-ray studies. The cecum is frequently tender, suggesting a state of congestion which would make absorption of toxic substances not only possible, but probable. Therefore, malnutrition in the slender type is common, and is inevitable under conditions of improper food and functional disturbance.

This malnutrition, as has been shown, is present in the atrophic cases only. The bone atrophy is general throughout the body and in all parts of the bones, particularly in those which are small and which have the poorest blood supply, such as the hands, feet, wrists, ankles. The first signs of atrophic arthritis are seen here. This is strongly suggestive that these bone changes are only part of a constitutional disturbance, the result of physiologic failure to supply bone nutrition in a type of individual already weak in this particular. Bacteria may cause this, improper food may be the cause, or improper function of the digestive organs or internal glandular disturbances, resulting in deranged chemistry of bone salts. All may be factors in some cases. My experience has been that removal of infection alone has very little effect in this arthritis, while very marked results can be produced by visceral readjustment.

The hypertrophic arthritic changes are an accompaniment of disturbed physiology in the heavy anatomic type, and seem to be an exaggeration of the normal tendency to heavy bone growth. The heavy anatomic type is less flexible than the slender type, because of the shape of the bones and because of the heavier musculature. Under strain or trauma of a joint, nature tries to limit motion and ultimately tries to lock joints by bony bridges, starting from the point of irritation. The periosteum in this heavy type becomes very active and repairs bone injury with heavy bone growth.

Under functional derangement this type seems to be retarded in its normal physiology; not only the lime salts show this retardation, but in other ways, such as gain in weight, increased blood pressure, slow pulse, sluggish digestive tract. The reaction to inactivity, as a result of pain in this type, is retarded metabolism as opposed to that of the slender atrophic type, whose activity is almost essential to better health.

A rather significant observation in the comparison of these three seemingly opposed joint troubles, and one which strengthens the belief that general physiology has much to do with the bone disease, is that during the menstrual period in the atrophic, the joint trouble is decidedly worse, whereas in the hypertrophic and infectious case little effect is produced. It is true that the slender anatomic type is more subject to menstrual disturbance than the heavy type. Pregnancy has no effect on the hypertrophic joint, whereas the atrophic joints are better during the increased physiological urge of pregnancy, but distinctly worse when the demand for better metabolism is removed.

This discussion leads to the point which seems of very great importance in the treatment, which is that these types of arthritis should be differentiated and treated according to the types for the best results. In the infectious group the bone salts are apparently handled without difficulty. The atrophic either does not get them in his food in sufficient quantities or is unable to handle them normally, due to physiologic disturbance, whereas the hypertrophic has an overabundance of capacity to handle them. It would seem, therefore, that in attacking these problems this should be considered. The tendencies of the anatomic types should be a great help to diet, exercise, general hygiene, and guidance back to health. Many cases of all types have spontaneously ceased to progress without aid from the medical profession, through some change in the resistance, functional capacity, immunity, or whatever we care to call it. We should, therefore, not alone direct our attention to the removal of foci of infection, but should do all in our capacity to raise the resistance, promote normal function, and control the chemical intake and regulate the life of the patient until health is regained. We cannot, of course, completely repair the damage done, but reconstruction should be attempted after the active stage has been controlled.

TREATMENT.

Treatment in each case involves two parts, the medical and the orthopaedic. They are so closely interwoven that they cannot be separated.

The medical deals with the arresting of the disease. The orthopaedic deals with the prevention and correction of deformity, leaving the patient in as nearly normal functional capacity as is possible. It is in this last capacity that medical and orthopaedic treatment can run side by side, because normal body function is impossible without normal body mechanics. The abdominal viscera cannot act to increase resistance with the stooped posture so frequently present in these patients.

It has been our experience that correction of body mechanics has been sufficient in some cases to turn the scale in favor of the patient and stop a downhill course. Again, it is only one factor, and the diet has to be suited to the weakened functional capacity, as Pemberton has shown.

It has been my experience that halfway measures with these arthritics, of whatever type, are unsatisfactory. They should all come to a hospital for study before active rational treatment can be undertaken. If impossible, they should be seen very frequently in order to locate the infection or control the diet or correct the body mechanics and general activity. Above all, the patient must be made to understand the meaning of coöperation. This can be done in a large hospital clinic, provided individual attention is given to each case. Unless such attention can be given, the case should not be undertaken.

The infectious arthritic must be painstakingly overhauled for local infections, chiefly in the alimentary tract or the genito-urinary tract. If these can be located through the history prior to the attack of joint trouble and on physical examination, the prognosis in early cases is exceedingly good. Later, it is a very difficult matter to eliminate the source, because it seems probable that subsidiary foci are started, like metastasis in malignant disease. Pemberton has given us a powerful weapon in these cases through his dietetic management.[4] Another is the increased elimination of intestinal waste and the effect of purgatives, as castor oil periodically, together with irrigations, and the increase of intestinal activity through massage, the promotion of general metabolism through baking (complete), and hydrotherapy. Locally, during the acute inflammatory stage these joints should not receive active or passive exercise. Protection, warmth, and any application which gives local relief is indicated. The salicylates should be employed sparingly. After the acute stage, active motion which does not stir up the joint to inflammatory reaction is to be encouraged, because the resulting stiffness will be less. Later, forced exercise of the stiff joints, or manipulation may be necessary for the restoration of function, but this most emphatically should not be undertaken for a long time after

all active arthritic signs have gone. The use of vaccines and non-specific proteins has met with no favorable results in my hands.

The tendency after removal of the infected tonsils, for example, is to sit back and wait for results. This cannot be too strongly warned against; in the first place, because it may not be the cause, and in the second place, much permanent damage can be produced in a joint shortly after the stirring up of a source of infection. The eliminative treatment should be pushed at this time and more care taken then than before or after. It has been my practice to prepare a patient most carefully for removal of an infectious focus, even waiting some time until the body has acquired greater resistance through building up, rest, exercise if possible, before subjecting him to a large dose of toxin, when he has already been seemingly overwhelmed. I believe it makes for less permanent damage in the long fight.

Patience and time are two indispensable factors in recovery. Dogged determination in the physician and patient is necessary. Brilliant results at times are seen, but in most cases it is a long battle with frequent discouragements. Occupational therapy is a great asset to the physician, because it not only helps to limber stiff joints, but promotes better morale during the long days of expected results.

In the atrophic arthritic, as I have attempted to show, we are dealing with a more complex problem. My experience with regard to foci of infection in this group is very discouraging, so much so that it has made me skeptical as to the infectious origin of the disease. On the other hand, attacking the problem from the anatomic type standpoint has given much more satisfactory results. Remembering the general state of lowered vitality, malnutrition, and functional visceral disturbance, the diet has been normal in amount, even increased by small quantities between meals. Often these fish-hook stomachs will stand only small quantities at a time and require frequent meals. The diet should be well balanced, with plenty of fruit, such as orange juice, and fresh green vegetables for the mineral salts in them. It has been our experience that the sore gums, retracted and red, improve with orange juice, much as if they were the gums of the scurvy patient. The diet must be simple, not rich, and not highly spiced, as these patients tend to hyperacidity and gastric irritation. There should be enough green bulk to give the intestines material to work on and to push through the cecum. This, with massage of the cecum, will help to correct a cecal pocketing

at the redundant sagged tip. Massage also helps to alleviate the congestion and tenderness in the lower right quadrant.

Much still remains to be found out about the food problem in these cases, especially as regards the lack of mineral salts of our highly refined foods, such as cereals and starches, sugars, etc. This may be the reason for the bone salt deficiency in these cases, as well as the general nervous and epithelial malnutrition found. (We can make no statements as yet.)

The next problem is one of increasing the patient's capacity to utilize food. The patients have a struggle to gain weight even when not ill. The amount ingested seems to make very little difference to them. The trouble is more fundamental than calories; it is a question of functional capacity. The problem is one of body mechanics, as it is in all slender congenital visceroptotic people. The viscera cannot handle food successfully if the diaphragm does not pump back the venous blood supply; the liver, spleen, pancreas, kidney, and especially the small intestines, cannot do their work if handicapped by downward pressure, congestion, and mechanical kinking present when the body is improperly used.

Body mechanics, as shown by Brown,[15] Goldthwait,[16] and others,[17] is a tremendous factor in the functional derangement of the viscera and nutrition. Consequently, it has been our practice to begin correction of body mechanics, such as round shoulders, relaxed abdomen, sagged back, contracted ribs, etc., at first by recumbency, during which body exercises, such as breathing, rib stretching, abdominal stretching, abdominal exercises were employed; later, with active standing corrective exercises and, if necessary, corrective apparatus.

It has seemed that little could be done locally for these atrophic joints except to promote circulation, though hyperaemic, with heat, massage, packs, etc. Medicinally, we have used chiefly soda bicarbonate, with good results apparently. Its use has been empirical because of the acid tongue. Not infrequently soda has acted quite as well as aspirin in relieving pain, giving better nights, and clinically has helped reduce congestion of the joints. Medicinal tonics and stimulants have appeared to be of no permanent value except as appetizers. The mineral salts apparently have little effect in their present chemical forms.

The orthopaedic care of these joints presents many problems, because of the tendency after cartilage destruction to bony ankylosis. The more motion a patient can keep during the active stage, even if it produces

congestion, the greater the advantage. These patients should not remain quiet long, but should be encouraged to activity as far as compatible with gain; but as they are easily fatigued, the line has to be very carefully drawn.

Very little can be done operatively in the reconstruction of these joints. The hands, however, offer a huge field for more reconstructive surgery, as the hands usually are badly deformed and cause much incapacity for ordinary pursuits, oftentimes the only usable parts of the patient, if the case is a severe one. With the better physiology, weight is gained, the nutrition of the skin first; the nails, hair, and muscles improve, and the bones, although they never apparently repair the destruction wrought, become denser as time goes on. It is interesting to note that as general health returns, the menstrual period becomes less and less a time of setback.

In the hypertrophic case the treatment is directed toward whipping up the retarded metabolism through exercise and activity. The diet is bulky, not too nutritious; laxative food such as vegetables, greens, stewed fruits are given, and plenty of water. Regular catharsis is indicated, as the bowel function is constantly sluggish. We have found that sodium phosphate is very effective, not only as a cathartic, but as a mild diuretic. The coated tongue, so frequently found in these hypertrophic cases, cleans up under its use.

Body mechanics again comes into play because of the acquired visceroptosis present in these long intestined, heavy viscera people. As they become less and less active physically the abdominal tone is lost and visceral sag results, causing more sluggishness of the bowels. This has to be corrected by supports and exercises until the abdominal muscles have regained their strength and tone, and the posture has been restored to a better point for relief of strain. As is so often the case, the arthritis is located in the knees and lumbar spine of the hypertrophic cases. One is called on to relieve all strain to these regions, and here probably is the chief reason for correction of body mechanics and the use of supports, foot plates, etc., in the hypertrophic case. Some of these cases have shown a low basal metabolism, and results of surprising quickness have been obtained in a few cases by the use of thyroid and ovarian extracts when combined with the foregoing outlined treatment.

Conclusions:

1. There are three distinct types of arthritis: infectious, atrophic, and hypertrophic.

2. These types differ etiologically, pathologically, and clinically, and in x-rays.

3. They respond to treatment differently and should, therefore, be differentiated.

4. Clinical data seem valueless unless these types are studied as separate pathological entities.

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THE OPERATIVE TREATMENT OF SCOLIOSIS.

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For more than a decade orthopædic surgeons have been studying the subject of scoliosis with particular interest. This study was interrupted by the Great War, but it has been resumed again in another form and promises to continue to be one of the subjects which will interest those engaged in the treatment of lesions of the bones and joints.

The work of Abbott, of Portland, in June, 1911, was perhaps the greatest stimulus to this study, although the work of Feiss,* of Cleveland, on the physiology and mechanics of the spinal column, which preceded the work of Abbott, should never be forgotten.

In June, 1911, the writer drew the attention of the members of the Canadian Medical Association to the fact that rotation of the thorax in one direction caused rotation of the vertebrae in the opposite direction. This seemed to be a paradox. The writer does not know whether it ever had been described before.

It was suggested that these physiological principles could be made use of in the treatment of pathological scoliosis. During the years 1911 to 1914, inclusive, Dr. Z. B. Adams of Boston and the writer, in Montreal, endeavored to evolve a rational scheme for the treatment of scoliosis by the production of physiological scoliosis of a reverse character to that of a pathological scoliosis already existing.

In 1914, before the Great War, the writer addressed the American Orthopedic Association, saying that practical experience had proved that because pathological scoliosis was a more advanced process than physiological scoliosis, it was useless to attempt to cure pathological scoliosis by superimposing physiological scoliosis of a reverse order upon the pathological scoliosis already existing, because the lesser could not be depended upon to cure the greater.

At this meeting the writer expressed his conviction that no effective form of treatment had been found for pathological scoliosis where bony changes had occurred. Posture, pressure, exercises—all had failed and would continue to fail. The hope of the future seemed to lie in operative procedures.

For some years the Medical Staff of the Children's Memorial Hospital in Montreal had been preaching that few cases of extreme scoliosis attain old age. Many died from circulatory disturbances due to obstruction caused by thoracic deformities.

In 1915 the Committee which had been appointed by the American Orthopedic Association to report on the treatment of structural scoliosis reported unfavorably on the progress made by patients treated in Boston by the method which had been practised by Dr. Adams, of Boston, and the writer. This statement caused no surprise, because, a year before, the attention of the American Orthopedic Association had been drawn by the writer to the fact that pathological scoliosis could not be cured by superimposing physiological scoliosis on it. The less could not cure the greater. Something more is necessary.

An examination of the Report of the Scoliosis Committee of 1915 showed the following words:

"Of the six cases thirteen to seventeen years of age which have been treated by the rotation treatment—they were all in fairly good condition, but in two cases collapse seemed imminent after the jacket had been removed and the patient kept standing for inspection. Not only had over-correction not been secured in any case, but in none was there marked diminution of any of the elements of the deformity. . . . The Committee feels justified in considering the results as distinctly discouraging."

The Committee was justified in feeling discouraged if it were looking for cure or even marked improvement, because this treatment had been condemned by its sponsor a year before.

The Committee's report was a valuable contribution because it drew attention to the fact that two cases out of six had shown signs of collapse when, by the removal of the jacket, they had been permitted to relapse into a position of pathological scoliosis. There had been no collapse when placing them in a position of physiological scoliosis.

It is important to bear in mind that the deformity of scoliosis, as seen by the surgeon, is simply an outward and visible sign of a very much more marked deformity which obtains in the interior of this region.

Theory and experiment have likewise proved the importance of increasing the capacity of the thorax in cases of scoliosis, in order that the thoracic organs may be in the best possible position to function.

This can be done best by placing the patient in a position of physiological scoliosis, the reverse of the pathological scoliosis from which the patient suffers.

From our point of view the key to treatment was the discovery of the physiological fact that rotation of the trunk in one direction or side-bending of the trunk in one direction causes rotation of the vertebrae in another direction.

We have felt, then, that in cases of scoliosis, be they mild or be they severe, treatment must be based on the necessity of placing the vital organs, as well as the thoracic walls, in a position of the greatest possible correction.

We had, as early as the end of 1913 and the beginning of 1914, decided that there are a large number of cases of scoliosis which do not respond to any known method of treatment. Further, we had agreed that the hope of the future seemed to lie in operative procedures. The next step was to search for an operation which would be a rational procedure from the point of view of the etiology of the condition.

All of us realize that scoliosis may be due to a great many different causes. For the purpose of this paper let us consider three of these: (1) An unstable base to the spine; (2) A loss of stays; (3) Congenital malformations.

1. *An Unstable Base.* Dr. Adams claims that in the majority of cases of scoliosis the deformities are due to irregularities of the last lumbar vertebra, causing an unstable base for the superimposed segments of the vertebral column. Undoubtedly this statement is true in a goodly number of patients afflicted with this condition.

Here the operative procedure must aim at the creation of a stable base for the superimposed vertebral column. Here the body of the fifth lumbar vertebra seems to be primarily at fault. Here the body must be so repaired or its position so changed that it will be made to afford a sufficient pedestal for the vertebral column.

2. *A Loss of Stays.* Our Montreal experience demonstrates that in a large number of the severe cases of scoliosis the etiological factor will be found to be an irremediable weakness of muscle due, for instance, to such form of paralysis as that due to poliomyelitis. Here operative procedures must aim at stabilizing the spinal column.

3. *Congenital Malformations.* English observers claim that, in a certain number of patients suffering from scoliosis, congenitally wedge-shaped vertebrae will be found to be the cause.

SUITABLE CASES FOR OPERATION.

1. Only such cases as are becoming progressively worse are suitable for operative procedures.

2. Those cases in which temporary improvement can be obtained by non-operative procedures are suitable for operation. Each case is subjected to a careful examination before operative procedures are considered. It must be possible by traction on the spine or by traction combined with rotation or side-bending to secure considerable correction before operative procedures can be, with fairness, considered. The patient's general condition must be good enough for him, or her, to stand a severe operation.

OPERATIONS.

It has been seen, then, that two forms of operation are indicated,—first, the operation which should be decided to meet the theory that the cause of scoliosis is a lack of stability of the base of the spine due to an unequal development of the lateral segments of the fifth lumbar vertebra, and, second, an operation to stabilize a vertebral column, which lacks support of muscle or ligament following a paralysis.

1. *Operations on the Fifth Lumbar Vertebra.* I do not know of any operative procedure which has been devised for the correction of the architecture of the fifth lumbar vertebra. Dr. Adams of Boston has always insisted on the importance of making this discovery, and, I understand, has made many experiments along this line. Personally, I am convinced that in those cases in which the etiological cause of scoliosis lies in lack of development of the fifth lumbar vertebra, the anterior surface of the bone of this vertebra must be approached through the anterior abdominal wall, while the patient is in the Trendelenberg position. The promontory should be exposed, and a portion of the disc between the fifth lumbar and the sacrum removed, in order that it may be replaced by a wedge-shaped bone graft which, it is hoped, will assure a stable base for the vertebral column. Although this operation has never been practised, and although it would seem to be a very severe one, my experiments with the cadaver have led me to believe that it would be possible, and, in cases where scoliosis was potentially severe enough to justify its performance, it might be considered. Further than this I cannot go.

2. *Operations for the Stabilization of the Spine.* There are at least three operations for the stabilization of the spine.

(a) Albee's operation. Those who consider bone grafts as suggested by the pioneer Albee as an efficient means for the stabilization of a number of vertebrae employ the Albee operation.

(b) Hibbs' operation. Those who prefer the mechanical perfections of Hibbs' operation employ that procedure for the stabilization of the spine.

(c) Other operations. In Montreal, we have felt that neither the Albee nor the Hibbs operation is suitable for the stabilization of large numbers of consecutive and adjacent vertebrae. We have devised, then, an operation for the treatment of such conditions. This was described in the September, 1920, number of the *Journal of Orthopaedic Surgery.*

GENERAL CONSIDERATION.

Operations must be undertaken only after sufficient consideration. In many cases the deformity is already arrested; thus attempts to arrest are not indicated. The possibility of success may be shown by the amount of correction which is possible by forcible extension and rotation. We must not perform an operation for the fusion of vertebrae unless we are sure that the procedure chosen will really produce a fusion which will not fail when subjected to stress and strain, which stress and strain, of course, is directly proportional to the number of vertebrae fused.

We must not submit a patient, whose vital organs are working at disadvantage through thoracic deformities, to a lengthy and shock-producing operation if shock can be minimized by operating in two stages.

If it is considered advisable to fuse both the dorsal and lumbar vertebrae it is, perhaps, wisest to fuse these two regions at two different times. It is our custom in Montreal to operate on either the dorsal or lumbar vertebrae at one time, to secure the greatest amount of correction possible and to maintain this by the use of a plaster jacket for six months. At the end of that time, a second jacket may be applied and the same treatment may be carried out.

In considering the question of operative procedures indicated for the relief of scoliosis the etiological factor responsible for the specific case under consideration is of prime importance.

AFTER-TREATMENT OF OPERATIONS FOR SPINAL FIXATION.

Immediately the operation has been performed the patient is, by traction and rotation, placed in a position of the greatest possible correction. A plaster jacket is then applied while the patient is still under the anaesthetic. This procedure is, undoubtedly, the best, although it is not practicable in some cases where the patient's general condition will not permit of the application of the plaster jacket under anaesthesia. In these cases the plaster jacket can be applied some days or weeks later. These latter do not, however, suffer that minimum amount of discomfort and lack of pain seen in those who are placed in immobilization while still under an anaesthetic. They are maintained in such plaster for six months, and during half of this time they are kept in recumbency.

RESULT OF TREATMENT.

While I consider this procedure to be a very severe one, I am happy to be able to report that no patient has died during or immediately following the operation. On the other hand, one patient in ten who have been operated upon died of pneumonia two days after operation, and, while we feel sure that this pneumonia was due to the operation, death can hardly be considered as being caused by this particular procedure. Every patient has claimed improvement in her general condition after operation. The patient's height has been greater after the procedure, although I cannot be sure that the increased height which was originally seen, and which it had seemed possible to attain before the operation by extension and rotation or extension and side-bending, has been maintained. We have endeavored to prove by X-rays that bony union occurs, but because of the position of the operation on the bone, hidden as it is by the bodies of the vertebrae, we have been unable to do so, although we have, on several occasions, when doing our secondary operation, been able to demonstrate a broad ribbon of bone extending from vertebra to vertebra on the posterior surface of the angles of the vertebrae. This ribbon of bone, which covered the posterior surface of the angles, seemed to us to be of sufficient strength to maintain the correction secured.

CONCLUSION.

We feel that, although operative procedures for scoliosis cannot be considered to have stood the test of time, they have been sufficiently encouraging to permit us to continue their employment. We have never operated for cosmetic effects and we have purposely operated only in a limited number of patients under the conditions already mentioned. We hope that the day will come when the field of usefulness of operative procedures may be extended, but we would hesitate to recommend their general use, because, as we have already stated, the operation is a severe one. It should not be carried out except after deep thought and consideration, and then only by those who are accustomed to operate on the spine. Perhaps at a later date its field of usefulness will be broadened, but until we have been able to prove the enduring character of the ankylosis and the general benefit to the patient, as shown by increased height and marked improvement in general condition, we have no right to employ it except in desperate cases.

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FURTHER OBSERVATIONS ON INTRA-PERINEURAL NEUROTOMY IN SPASTIC CONDITIONS.

BY JOHN JOSEPH NUTT, M.D., NEW YORK.

In June, 1909, at the meeting of the American Orthopedic Association held at Hartford, I reported two cases of intra-perineural neurotomy, one of which I presented. Since then I have performed the operation 27 times, and it would seem proper to make a further report upon its usefulness.

The operation has no effect upon the pathological condition. It is in no sense a cure. It is purely symptomatic treatment, and the best to be expected from it is an alleviation of the incapacity caused by the original injury or disease.

The names generally used for the condition under discussion are: cerebral spastic paralysis, infantile spastic paralysis, hemiplegia, spastic paraplegia, and Little's disease. Although it was recognized as an entity by Nicholas Andry in 1741, it was first scientifically described by Little in lectures in 1843, and published in volume form in 1853. Fifty-two cases were reported by him in detail in a paper read before the Obstetrical Society of London in 1862.

Definition. A condition of spasticity of skeletal muscles due to loss of cerebral control and accompanied by varied phenomena due to nervous lesions. The mentality is usually affected. It is usually congenital or follows one of the exanthemata. The lesions are incurable, but the disability can be markedly ameliorated.

There are those who limit Little's disease to cases in which the pyramidal tract is involved, while others include cases showing the characteristic symptoms but not depending at all upon traumatism at birth.

Pathology. Thrombus of the superior longitudinal sinus and rupture of cerebral veins, caused by overlapping of the parietal bones during a difficult labor, is usually the predominant factor in causing this disease in congenital cases. This hemorrhage may be either subdural or intermeningeal. It may be quite general or limited to one

hemisphere. There are contributing conditions of inheritance which sometimes seem to be of importance.

The pathology has been described by Little, McNutt, Freud, Gowers, and Kundrat. As a result of the hemorrhage, certain cells of the cortex suffer edema and degeneration. Mr. E. Muirhead Little stated in 1907: "despite all the researches that have been so far made, it is impossible in the present state of our knowledge to predicate from the clinical features of a case what is the anatomical lesion causing it, and the converse also holds good; therefore, at present the pathology of infantile spastic paralysis has only an academic interest for the practical surgeon, whether he has to deal with the congenital or the acquired varieties of the disease."

The lower neuron is histologically normal. The muscles involved are held in tonic contraction, which is absent during sleep and narcosis. After a period the fibrous tissue in the muscles becomes shortened so that contractures exist.

Prognosis. There can be no restoration of lost nerve tissue, Any improvement depends upon the strengthening of cells weakened, but not destroyed. In that sense there can be no cure.

I would advise optimism in every case that is not of too low a mental grade. The undoubtedly idiotic and low-grade moron I do not consider should be given the time and attention which is so essential in all of these cases.

The majority of these patients can be made to walk with braces. Some may be able to discard braces, while others will need crutches as well, but improvement may be promised in every case. The satisfaction of reclaiming a patient condemned to a bedridden life so that he may be able to take his place in the usual activities of life with comparatively few restrictions, amply repays one for all the time and trouble.

Treatment. The only prophylactic measures possible are skillful obstetrics and means of controlling the hemorrhage as by increasing the blood coagulability.

Dr. W. J. Little and his contemporaries practised tenotomies, immobilization, and exercises. Today there are few who tenotomize any except the permanent contracted tissues. Simple tenotomy has been extended to, in some instances, resection of muscles and fasciae and tendon lengthening. It was early noticed that tenotomy for a single muscle did not limit its beneficial effects to that muscle: the spasm of other muscles would be diminished, and furthermore, other symptoms, such as general

nervousness and excitability would be favorably affected. It was the fact that improvement following tenotomies was not limited to the muscles operated on that led me to consider the advisability of putting a number of muscles out of commission for a protracted period. A more widespread benefit than from a tenotomy could thus be enjoyed, and the delay of waiting for contractures avoided.

Tendon transplantation has been practised for a number of years, more frequently with the biceps femoris than any other muscle. The majority of surgeons, however, feel that there is little to be gained by this operation over what is gained by tenotomy. The transplanted spastic muscle is not needed to reinforce a healthy muscle.

Arthrodesis, especially at the ankle, is a very satisfactory operation, as it gives a firm support to the leg, and is preferable to permanent deformities of the foot.

Förster devised the operation of radicotomy, which was performed by Tietze. It has been modified by Van Gehuchten. The operation has a mortality of 7 per cent. to 15 per cent., and is a tedious and an exacting one.

Allison and Schwab have paralyzed peripheral nerves by the injection of alcohol. This blocking of the nerves lasts for about three months.

Sharp, in cases which show intra-cranial pressure, performs the operation of decompression. He finds one out of three or four cases suitable for this operation, and has performed it several hundred times.

Stoffel resects a portion of some or all of the motor nerves to the muscle. The "nervous rest" is not widespread and is permanent. I frequently resect parts of individual nerves when it seems desirable in conjunction with intra-perineural neurotomy.

We shall confine ourselves to considering only cases in which spasm is the chief cause of the loss of function. The spasm may be limited to a few muscles, and yet, in consequence, standing and walking be practically impossible and render the patient incapable of mingling with other children. In such a case resection of part or all of the nerves to the muscles with, perhaps, myomectomy may be sufficient. In some cases the spasm may be sufficient to incapacitate the child and yet be susceptible by passive stretching and braces to an almost complete cure without any operative interference. After contractures are established, free movement of the joints must be restored before any other treatment is undertaken. Therefore, after eliminating cases of very low mentality, cases of pure contractures and cases of slight spasticity, we

have left a class in which, we believe, this operation should be considered.

Intraperineural neurotomy should not be performed except in cases that can be under the care of the surgeon for several years; otherwise the great expectations which may have been raised in the minds of the parents can result only in disappointment.

The Technique of the Operation. I have operated upon the sciatic, the popliteals, the posterior tibials, the obturator, and the anterior interosseus. In the larger nerves it is comparatively easy to suture the severed ends, while in the smaller nerves, as in the anterior interosseus, it is a difficult undertaking. After exposing the nerve, the neurilemma is divided by a longitudinal incision and the nerve itself lifted out. Two or three anchor sutures are placed above and below the site of the proposed neurotomy. The nerve is divided with a sharp knife, and the anchor sutures tied. The chief object of these anchors is to prevent rotation. With the nerve relaxed there is very little danger of separation at the ends. The sheath is then sutured and the part put up in plaster of Paris.

In most of the cases there is considerable pain for several days, which may demand the administration of an opiate. The time necessary for the nerves to grow to their nerve endings varies naturally with the distance. Cutting the sciatic paralyzes the muscles of the leg for about ten months. It is practically impossible to report cases in such a way as to be of any real value. They would be simply a series of cases in which the incapacities of the patient were described in detail, the date of the operation and the subsequent examinations. It would make a tedious report and confirm but little. Photographs might help, but the only ones of real value would be moving pictures. A moving picture of a child attempting to stand before the operation and the same child at intervals later on would be excellent, and I regret I have no such pictures to offer.

Our work has taught us some facts which, although trite, may be worth while calling or recalling to your attention. The patient's cooperation is a *sine qua non.* The personality of the nurse is of the greatest importance. All atmosphere of the patient being "queer," a "sight," a "curse," or a "nuisance," should be removed and replaced by an environment conducive to happiness, expectation, determination, and affection. Discouragement must be avoided at all times. The treatments must be carried out conscientiously, punctually; and if a nurse

cannot be had, a member of the family, or someone else, will have to give the time necessary.

At first, passive movements alone are used. In every untreated case some gain will be made within a few weeks. All the contractions are stretched, slowly, but firmly, with very little pain. The séance need last but a minute or two, as the attempt is not repeated more than twice or thrice at any one time. Each joint is systematically gone over. These exercises should be done three times or more a day. When all is gained which can be gained by this method, the remaining deformities are to be relieved by operation. Stretching under an anaesthetic is then performed, and tenotomies only of true contractures. If the calf muscles are in strong spasm together with the hamstrings and the adductors, intra-perineural neurotomy of the sciatic just below the gluteal fold with resection of the nerve to the semi-membranosus and adductor magnus, which usually branches off above this point, or the external popliteal division of the sciatic may be left intact, and its branch to the short head of the biceps resected. All the joints are forced through their usual range of motion, the patient is then encased in plaster of Paris from the toes to the axillae, with the hip abducted and externally rotated, the knee extended, and feet placed at a right angle to the leg.

Improvement may be noticed immediately in the general physical and mental condition, and after six weeks braces with a pelvic band, lock joints at the knees, and right-angle stops at the ankles, are applied. The patient is now encouraged to stand and to walk. These attempts are made at regular designated hours. As soon as possible the child is taught some occupation, if she has not one already, such as sewing, crocheting, drawing, etc. It may be possible to discard the pelvic band within six months, but the leg braces must be worn for several months after the restoration of the sciatic function. Three years of conscientious treatment with the assistance of a nurse, if possible, and of a member of the family, if not, should be counted on.

I will conclude with a description of one case. A girl, twelve years of age; history of congenital spastic paraplegia. Had stood up beside the bed, and by holding on to the chairs had taken a few steps. Never walked even with crutches. The family in very moderate circumstances, and the child allowed to remain in bed all the time, except when sitting in a chair. Had absolutely no contact with the outside world except through the family and a few intimate friends.

Upon admission to the hospital she was very well developed physically, but the mental development by Binet's test was of about five years of age; of a surly disposition, holding head down with eyes downcast, and seldom raising the head when spoken to; raising the eyes, but with no movement of the head. No contractures existed which could not be overcome under anaesthesia. Intra-perineural neurotomy performed on both sciatics, high up so as to include the hamstring muscles. The routine treatment as roughly outlined above was carried out.

Three years later the patient walked with crutches, but without braces. Some return of the spasm of the feet remains to be overcome. Patient attends school. Although still backward in her studies, she is not at all feeble-minded. She has a cheerful disposition, smiles readily, and her surly expression has changed to one of happiness and contentment.

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UNUSUAL FRACTURES.

Case Reports from the Orthopaedic Clinic of the Massachusetts General Hospital.

BY C. W. PEABODY, A.B., M.D., BOSTON, MASS.

A REVIEW of the acute fracture cases treated on the Orthopaedic Division of the Massachusetts General Hospital for the twelve months, beginning July 1, 1921, reveals three of sufficiently unusual nature to seem to warrant special report. The first of these presented the "cart-wheel fracture" of the textbooks, in which the leg is caught in a revolving wheel, the resulting torsion completely disrupting the lower end of the femur from the shaft at the epiphyseal line. Our patient was not caught in a cart-wheel, but knocked down by a motor-car, and in addition the break had the complication of being compound from the protrusion of the shaft through an external wound. Therefore, his very fortunate outcome seems quite striking. The second case is a fracture of the spine at a most uncommon point, and producing a skiagraphic impression which is rather startling. The neural arches of the first lumbar vertebra were fractured between the superior and inferior articular processes, the fragments separating as the spine hinged in flexion on the disc in front; so that the first glance at the x-ray gave the impression of a complete loss of bony continuity in the spinal column. The last patient, thrown from his horse, was caught under the falling animal, with a consequent rupture and complete dislocation of the pubic synchondrosis; the two halves of the pelvis, rotating in opposite directions, at the sacro-iliac articulations, produced a fracture of both transverse processes of the fifth lumbar vertebra. Perhaps the most remarkable fact in connection with this last case is his recovery without any internal complications. The three case reports follow:

CASE I. Richard B., white, aged 11. No. 237762. This patient was knocked down by a passing automobile and the left knee was injured. Received on the Service for treatment about five hours after the accident. Examination showed the leg an inch short and with normal knee contour replaced by an irregular deformity. There was a small lacerated

FIG. 1.—Case I. Lateral view of extended knee after consolidation. Note abundant callus anteriorly where periosteum had been raised from shaft.

wound in front of the biceps tendon, oozing freely, but when sponged revealing bare bone. X-ray plates taken at that time showed complete separation of the lower femoral epiphysis, which was displaced upward on the front, and a little to the inner side of the end of the shaft with the condyles looking forward. (These plates were subsequently much in demand and, unfortunately, destroyed at a demonstration.)

In view of the compound condition, surgical intervention seemed indicated, and was undertaken by Dr. P. D. Wilson, the writer having the privilege of assisting him therein. With the patient in the prone position the wound on the lateral aspect was explored and a débridement performed. The excision revealed the lower end of the femoral diaphysis lying subcutaneously, stripped bare of periosteum and grimy. The line of fracture was not at all jagged, and though irregular, was

FIG. 2.—Case I. A. P. of knee after union.

quite smooth and evidently represented the epiphyseal line. The epiphysis itself was displaced mesially and not seen, but seemed intact to palpation. No communication with joint space was found, the capsular attachments evidently remaining untorn around the epiphysis. The bone end was carefully sponged clean and the wound cavity wiped free of all blood and débris, no antiseptic being used. Manipulation for reduction was done before closing the wound. The first manoeuvre was traction in extension by one operator, and while still maintained, rapid flexion of the leg to 90 degrees by the other. This resulted in partial replacement, the condylar fragment still projecting a little anteriorly, but as soon as traction was relaxed it relapsed into the previous position. The

FIG. 3.—Case I.

FIG. 4.—Case I.

FIG. 3 AND FIG. 4.—Case I. Taken ten months after injury. The amount of knee valgus is in fact slightly greater on affected side.

second attempt was by a similar manoeuvre, but as soon as flexion of the leg was undertaken, heavy downward pressure was made over the popliteal space, counter thrust being obtained from a folded sheet between the table and the patella. This combination was entirely successful, the epiphysis being driven back over the end of the shaft with a snap, and remaining firmly in position despite free motion of the knee. Palpation in the wound then corroborated the exactness of the reposition, and the wound was closed in layers without drainage. A plaster cast spica was applied with the knee maintained in 90 degrees flexion.

Patient showed but slight shock as a result of the procedures and convalescence was uncomplicated and afebrile, the wound healing by first intention. At end of three weeks cast was removed and limb placed in a Thomas splint, a second piece attached by hinges at the level of the knee, carrying the lower leg and allowing protected motion, at first passive, later active, but always voluntary. In a little over two weeks complete active extension was possible, and six weeks after injury the patient became ambulatory in a plaster cylinder cast and

was discharged from the hospital. Two weeks later the patient discarded the cast and began walking with crutches. Examined in the Out-Patient Department at the end of two months was found to have full normal function with the exception of 10 degrees limitation of complete extension. At that time he was shown exercises to overcome this. He was not seen again until visited by the writer, 10 months after the injury, when the accompanying snapshots were made. Both legs showed some knock-knee, and this was a little more pronounced on the injured side; both showed the same normal hyperextension and equal motion in flexion. There was no shortening on the injured side or any laxity of the knee joint.

CASE II. Victor C., white, aged 10. No. 239432. This boy was transferred to the fracture service a few days after being admitted to the hospital with a fractured skull, dislocated elbow, and a fracture of the spine. The head injury had not proved serious, the dislocation had been reduced, but the injury of the spine was of such a peculiar character and so startlingly suggestive in its x-ray appearances of a serious weakness in structure, that a question arose as to the necessity for internal fixation. Spinal injury had been indicated on admission from the presence of crepitation and abnormal mobility over the spine of the second lumbar vertebra, and subsequent x-ray examination showed that a fracture had occurred on both sides at the junction of the neural arches and the laminae, so that one of the fragments consisted of the body, neural arches and superior articular processes, and the other of the inferior articulation, laminae and spinous process. A consequent slight separation thus brought about a complete loss of bony continuity in the spinal column.

On consultation it was agreed in this case that as the views showed no evidence of rotation or lateral dislocation, placing the spine in sufficient hyperextension should bring reapproximation of fragments, and stable union should occur from callus formation as normally in bony tissue.

The patient was treated by placing him prone in spinal hyperextension, moulding a plaster bed to his back in this position, and keeping him recumbent, supine in this shell for six weeks. A plaster jacket cast was then applied in this same attitude, and the boy went home ambulatory and free from symptoms. He returned to the O. P. D. a month later to progress into a brace, but an x-ray taken then for control showed a defect still present, and no shadow of callus formation. The jacket was accordingly continued for another month, at the end of which

FIG. 5.—Case II. Injury to 2nd lumbar vertebra. Fracture has occurred through both neural arches at junction of superior and inferior articular processes, the latter with the laminae and spinous process forming the lesser fragment. At the age of this patient the posterior part of the spine is not sufficiently calcified to show on the x-ray plate.

time x-ray examination showed gap closed and definite callus formation. Six months after injury no clinical evidence of injury could be found.

CASE III. Thos. W., white, aged 34, riding-master. No. 240464. This patient was injured about an hour before entry while training an unruly mount in the ring. The horse reared and went over backward, and the rider, throwing himself clear, landed, however, in a corner where he was caught by the animal rolling upon him. The man kept his head and legs out of the way, but the weight of the horse was received

FIG. 6.—Case III. Pubic dislocation, projected as if seen from behind.

for a second on his lower torso. At this instant he experienced a severe pain at the lower part of his back. He then rolled free and attempted to rise, but was prevented by great pain in the front of the pelvis and at the same time a deep grating sensation, described by him as similar to what he had many times felt in a horse with a broken leg. A doctor present gave him a quarter of morphia, put a swathe around his pelvis, placed him on a stretcher and sent him in to the hospital. Examination in the accident room showed a rugged man with dusky or ashen face and anxious expression, sweating profusely and with a general clamor. Lay on right side with knees drawn up, protesting against being moved and especially against separation of knees. Very tender over lumbar area and over sacro-iliac region both sides. Careful passive motions of hips possible in moderate range. Compression of iliac crests elicited no symptoms. Forward pressure behind left great trochanter caused deep heavy crepitus and pain not definitely localized. Same from pressure under tuberosity of left ischium. There was no spasm or rigidity of abdominal muscles and no bleeding from

urethra. Could not urinate but stated that he had emptied bladder just before mounting. Patient was sent to x-ray with diagnosis of fracture of both rami of left pubic bone. The resultant plates failed to show such lesion but revealed complete dislocation of the pubic synchondrosis, the left side being below the right, and also fractures of the transverse processes of the fifth lumbar vertebra.

The outstanding feature of the immediate course of this patient was the very slow recovery from shock. He was always conscious, rational and collected, but for several days experienced what he described as a sensation of impending dissolution. His body remained cold and clammy, with frequent general fine tremors entirely uncontrollable. Stimulative treatment had little effect save to increase insomnia and for a week sleep was possible only with maximum depressants. Did not void spontaneously till fourth day, but urine at no time contained blood. Reduction of the dislocation was sought by suspending the pelvis in a canvas hammock having a fixed support on one side and weight sufficient to elevate one buttock on the other. Palpation indicated some improvement in the deformity felt at the symphysis, but not complete reduction. The patient's condition made manipulation seem unwise for the time being. At the end of a week a general anesthetic was given, the pelvis manipulated guardedly until the relation of the bones felt normal, and a double plaster spica applied. X-ray examination made through the cast was too indistinct to furnish accurate evidence of the completeness of the reduction, but the patient was made quite comfortable. He was kept on a frame in bed for six weeks, when a low plaster jacket was substituted for the double spica and he was allowed up for a few minutes daily on crutches. In two weeks he was able to navigate very well and left the hospital ambulatory, wishing to continue treatment at the office of a member of the staff. We neglected to obtain a final x-ray, but the surgeon to whom he went reports a subsequent examination showing normal relation of parts. The plaster jacket was soon exchanged for a supportive corset and the man went back to work. Four months after injury he was riding again and testified to no incapacity or disability that he could notice.

Certain points may be presented for discussion in these three cases. A hasty consideration of the factors involved in all easily leads to the thought of operative fixation. The advantage of internal fixation in many forms of bone and joint lesions is becoming increasingly recognized, but to many it also seems that the possibility of successful

results from external measures in the great majority of cases is not sufficiently kept in mind.

It is our opinion that reduction in the first case could have been just as easily and as accurately secured if the necessity for débridement and exploration had not been present. Once accurately secured, maintenance of the epiphyseal fragment in apposition was attended by no difficulty beyond the careful application of a plaster dressing, and the shift to a double Thomas splint allowed motion without danger at a stage early enough to preclude adhesions. In connection with this point it should be mentioned that Cutler reported a similar injury, not compound, which was successfully treated by external measures.[1]

In Case II a proper argument arose as to whether consolidation could be surely expected and the danger of a weak spine, with subsequent deformity, be dismissed unless a bone graft were placed across the involved area. A careful study of the x-ray picture and the mechanics involved indicated, however, that the danger was more apparent than real. At this point in the spine, which normally shows a lordosis, the weight is carried only partially on the vertebral bodies, and on account of the center of gravity of the overlying trunk being posterior to them, there is also a considerable downward thrust against the pedicles through their articular processes. So the fragments in this case would not tend to separate in the erect position as the x-ray suggests, but would be forced together. But a mistake was made in the treatment which probably delayed the reapproximation and final union. Hyperextension would, of course, tend to bring the fragments in apposition. It was accomplished in the supine position on a plaster bed. This meant that a thrust was made upward or anteriorly over the spinous processes of the involved segment. The direction of these processes being oblique to the surface, the first effect of pressure on them would be changed into leverage with the two affected facets offering the fulcrum and the articular processes at the point of fracture tilting backward and away from each other, instead of together. Further backward flexion of the spine, of course, brought some approximation, but in less perfect alignment. A little study of the exposed vertebrae in a skeleton was required to make this clear to us. Obviously the hyperextension would have been maintained better on a shell in the prone position and the bad effect described avoided.

Case III was interesting for one reason in the analysis of the cause of the fractures of the transverse processes of the last lumbar vertebra. The examination of the patient and review of the circumstances attend-

ing his injury made it seem improbable that any direct violence could have been applied at these points. It did seem possible that with the abnormal motion of ilium on sacrum permitted by the pubic rupture, indirect violence might have been transmitted through the stout ligamentous bands between the tips of these processes and the crests of the ilia. It will be noticed in the x-ray that the line of fracture in each is well out toward the tip. Another point arises from the fact that the amount of separation of the two pubic bones would seem to indicate a complete rupture of the ligaments between them, with the suggestion that even if reduction were secured, the resultant union would be unstable and some sort of operation such as wiring indicated. By just what method nature effects a sufficiently strong consolidation here we are unable to say, and complete reduction was not secured for some time after injury. But the fact that at this writing the patient for two months has been able to train spirited hunters is sufficient evidence that nature has done the job as effectively as could the surgeon with drill and wire.

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"FLAT HAND" (MANUS PLANUS): ITS CORRECTION ESSENTIAL TO NORMAL FUNCTION OF HAND.

BY JOEL E. GOLDTHWAIT, M.D., BOSTON, MASS.

At the meeting of the American Orthopedic Association held in Washington in 1913, a paper was read by the writer upon "The Carpal Arch: The Importance of Its Development in the Function of the Hand."

This paper was published in the *Zeitschrift f. orthopädische Chirurgie* at the request of the Publication Committee of the American Association, which was at that time endeavoring to arrange an exchange of scientific contributions between the orthopædic groups at home and abroad. Probably because of the limited reading of the *Zeitschrift*, very few even of the members of our Association know of this article, and since this structure does not seem to be recognized in the treatment of the common injuries or diseases of the hand so that unnecessary crippling results, the article has been rewritten, with such additions as have naturally resulted from the experience since the original article was prepared.

The war casualties have served, probably as nothing else could, to emphasize the importance of preserving functional elements which under civil conditions would receive little attention, and in the hand especially, where very slight degrees represent the difference between a useful or useless member, it becomes extremely important that the mechanics of the function of the hand be thoroughly understood. Limited motion in the carpal joints may cause little disability, but the faulty adjustment of the bones may cause great disability. A flat carpal arch which cannot be corrected by the contraction of the muscles makes impossible the normal grip of the hand, as well as the approximation of the thumb to the fingers, which naturally prevents all delicate use of the hands.

To fully understand the mechanism of the function of the hand, it is necessary to refer to the anatomy, which shows that the hand is so formed that in repose the palmar surface is concave both longitudinally and laterally. (Figs. 1 and 2.) The bones of the carpus are arranged so that there is a well-marked arch transversely, this being more pro-

FIG. 1.

FIG. 2.

FIG. 2.

nounced in the second row than the first. The first row is not only arched transversely with the concavity toward the palm, but the bones are also arranged so that they form an arch, the concavity of which faces forward toward the fingers. Into this latter arch the proximal portions of the os magnum and unciform bones fit (Fig. 3), and the stability of the arch formed by the first row naturally depends considerably upon the position of these two bones which fill the concave portion. Not only is this true in regard to the stability of the first row, but the grasp of the first row upon the unciform and os magnum

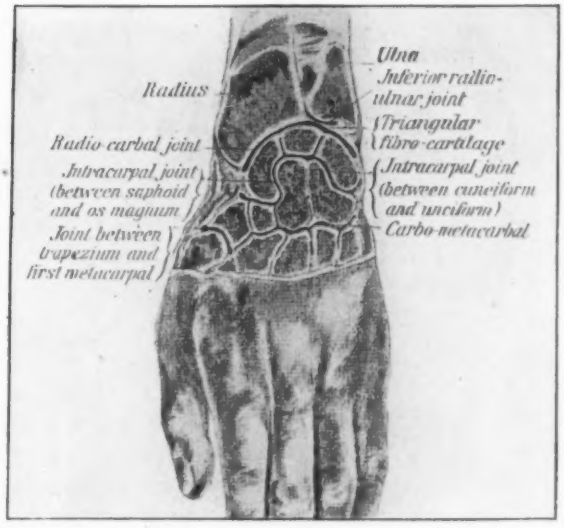

FIG. 3. (From Gray's Anatomy.)

serves to maintain to a very considerable degree the arch formed by the second row. The trapezium and trapezoid rest upon the distal end of the scaphoid (Figs. 2 and 3) and their distal surface is on a line with the distal surfaces of the os magnum and unciform. The trapezium is placed so that it projects much more into the palmar surface of the hand than do the other bones.

The distal surface of the second row of carpal bones is practically transverse (straight across) and against this rest the ends of the second, third, fourth, and fifth metacarpal bones. The first metacarpal is placed more anteriorly (Figs. 1 and 2), resting directly against the distal surface of the trapezium. In the articulation formed by the second, third, fourth, and fifth metacarpal bones with the carpus, there is comparatively little motion. In the articulation formed by the first metacarpal and the trapezium there is quite free motion, and the function of the hand depends to a very considerable extent upon the movements allowed at this joint. The surface of the trapezium at this articulation represents a section of a cone, and the movement of the base of the first metacarpal bone is a sliding one around this conical surface. This is clearly shown if the movement of the thumb is watched from the position of full extension to full adduction of the thumb on the hand, with the thumb itself kept straight. When the hand is in full

extension, if viewed from the palmar surface, the nail of the thumb is scarcely visible, while the palmar surface or ball of the thumb is almost wholly visible. With the adducted thumb, the palmar surface of the thumb, or the ball, is practically entirely hidden, while the nail is wholly visible. It is evident at once that this can be accomplished only by the movement of the base of the thumb, which is accomplished as the first metacarpal slides about on the conical surface of the trapezium.

Not only this, but the function of the fingers depends to a very considerable degree upon the arched structure of the carpus. When the fingers are fully extended with the arch preserved, they spread out in fan shape, following the direction of the metacarpals. When the fingers flex, however, they draw toward the median line. The middle finger flexes in the line of its metacarpal; the others flex toward the middle of the palm. The index finger draws toward the ulnar side and comes in contact with the tip of the middle finger; the ring and little fingers draw toward the radial side so that the ends of the fingers are in contact at the sides, while the tip of the thumb comes in contact with the tips of the other fingers, but facing in almost the opposite direction. This convergence of the finger tips to a common point is absolutely essential to the delicate use of the hands, and is impossible unless the carpal arch is preserved.

With the carpal arch obliterated, in flexion of the thumb it is impossible to touch the finger tips or to touch the palm of the hand. The fingers may flex, each upon its own metacarpal, but without inclining toward the median line, and consequently without coming in contact with the others. No delicate function is possible under such conditions.

The higher the arch the more will the little finger incline toward the median line in flexion, and the farther will it be possible to carry the thumb beyond the median line.

The maintenance of the position of the carpal bones depends, as is true in the arch of the foot, upon the muscles and ligaments. The muscular elements include nearly all those that have to do with the function of the hand, wrist, and fingers, the short muscles being of particular importance. Of the ligaments, there are many small ones connecting the individual bones, while more superficially on the palmar side is the strong annular ligament, and beside this the palmar fascia is of very considerable importance. In the space made by the arch of the carpal bones and the annular ligament run the tendons of the long flexor muscles as well as the nerves and blood-vessels which supply the hand.

FIG. 4.—High arched hand. Note the narrow width of the carpus in relation to the length from radius to metacarpus. Note also narrow width of carpus to length of hand and fingers.

With the carpal arch, as with the tarsal arch, the height is not constant. At times it is relatively high (Fig. 4); at other times low (Fig. 5), with the average a more strictly normal between, and this is true not only of the transverse arch, but also true of the arch formed by the first row of bones into which the os magnum and unciform bones fit. In the high arch the line of the carpo-metacarpal joints is nearly straight across the hand (Fig. 4), while in the low arch or the high arch which has given way, the line is curved convex forward (Fig. 5).

Not only is this true, but the shape of the trapezium, especially the shape of the articulation against which the first metacarpal bone rests,

FIG. 5.—Low arched hand. Note breadth of carpus in relation to the distance from radius of metacarpus. Note also breadth of carpus in proportion to length of hand. Contrast with FIG. 4.

varies within considerable limits. At times the plane of the articulation is nearly horizontal (Fig. 4); at other times the axis has a marked oblique inclination (Fig. 6). The effect of such difference upon the stability of the joint is probably at once apparent. If the axis of the joint is oblique there is a natural tendency for the metacarpal bone to slide off the trapezium whenever the muscles are tightened and the thumb is held straight in the line with the other fingers. The only time when the bone rests firmly against the articulation is when the thumb at its base is abducted. This obliquity will increase as the arch flattens and will be lessened by heightening the arch. In the natural use of the hand in everything that involves the use of much strength,

FIG. 6.—Moderate degree of flat hand. Note the way in which the scaphoid has fallen away from the os magnum. Note also the oblique axis of the joint of the trapezium against which the first metacarpal rests.

especially in grasping objects, the thumb is flexed at the phalangeal and metacarpo-phalangeal joint but is extended at the carpo-metacarpal joint. In this position the metacarpal bone rests squarely against the articular surface on the trapezium, and the application of the force in the contraction of the muscles holds the base of the metacarpal bone firmly in place. Any action made with the thumb straight and in line with the other fingers must necessarily mean strain to the carpo-metacarpal joint, with a tendency for the first metacarpal to slide off the trapezium.

FIG. 7.—Naturally high arched hand with arch flattened. Note the flattening of the first row of carpal bones with the scaphoid separated from the os magnum. Also the trapezium and pisiform are displaced outwardly. Compare with corrected position in Fig. 8.

If such a condition of partial displacement of the base of the first metacarpal is present, the effect of the contraction of the muscles of the thumb, both extensors and flexors, is exerted abnormally, and it becomes increasingly difficult to flex the thumb at the metacarpophalangeal joint. Under such conditions, instead of the thumb flexing, the muscle pull still farther displaces the base of the first metacarpal and results in hyperextension instead of flexion of the metacarpophalangeal joint, with possible slight flexion of the phalangeal joint.

If with such a joint the ligaments become strained or the carpal arch becomes weakened so that the inclination of the axis of the joint is still further increased, displacement of the metacarpal bone outward be-

FIG. 8.—Correction of flattening of arches with wrist strap. Same case as Fig. 7.

comes a matter of great ease, with the result that many times the displacement becomes permanent and results in marked disability.

The condition of the carpal arches as to strength and the position of the bones depends, as is true of the tarsal arches, largely upon the tone of the muscles, the ligaments naturally not being materially stretched unless the muscle tone has become so weakened as to throw the strain upon the ligaments. As is true also of the tarsal arch, a condition of marked relaxation of the bones and flattening of the carpal arches may exist without material interference with the function of the hand. This, of course, is to be explained by the fact that the tone of the muscles is such that they are able in their contraction to easily draw the bones together and hold them in proper position to enable the normal function to take place. If, however, the tone of the muscles becomes lowered as the result of sickness or inactivity, the condition then bebecomes a matter of much more seriousness. At such times not only is

it impossible for the normal relation of the bones to exist without proper tone of the muscles, but it is equally impossible for the proper tone of the muscles to develop unless the proper relationship of the bones and the maintenance of the arches exists. At such times the muscles may be able to draw the bones into place, but they may not be of sufficient strength to keep them there during use of the hand. This was exactly the condition (Figs. 7 and 8) when the use of a support was absolutely necessary in order to make use of the hand possible without pain and in order to allow the ligaments and muscles to strengthen.

To appreciate fully the importance of the proper tone of the supporting structures of the arch in connection with the function, it should be remembered that the tendons of the long muscles, which flex the fingers and thumb pass under the annular ligament and on the ulnar side, exert their force partly around the hook of the unciform as a fulcrum. On the radial side the trapezium becomes the fulcrum, and upon this side, because of the strong thumb flexors, the force exerted is greater

FIG. 9.

than that which is received upon the unciform. As long as the arch is well maintained the bones hold the tendons well in place, but when the arch flattens the whole palmar surface spreads, with the natural result that the hook of the unciform slopes outward instead of inward, and the trapezium becomes an inclined plane, off which the tendons must slide into the soft structures. In this position the tendons not only are unable to work rightly, but tend in their contraction to still further spread or flatten this arch. In this position, also, the extensor tendons, which should pull across the back of the first metacarpal and hold it in place, must exert their pull at the side of the base and still further force the bone out of place. Not only this, but the extensor tendons, especially the extensor secundi internodii pollicis, are strained in their grooves on the outer side of the lower end of the radius, with developing pain at this point. The clinical picture of pain referred to this point at the "base of the thumb," but actually over the outer face of the radius, is to be explained commonly in this manner.

The treatment of such conditions naturally consists, first, in restoring the bones to their proper position, and in the second place improving the tone of the muscles and ligaments, in so far as is possible, to maintain this position. Many times the condition is entirely an expression of weakness, and properly supervised exercises will be all that is required. At other times, because of the peculiar application of the force of the flexor muscles to the trapezium and to the hook of the unciform, it is necessary to temporarily supply some form of support un-

FIG. 10.

FIG. 11.

til the muscles and ligaments can have regained enough of their normal tone so that this support can be dispensed with. The support that has given the greatest satisfaction to the writer is pictured in Figure 9. This consists of a strap buckled about the wrist (Figs. 10 and 11), making pressure over the lower part of the carpus, with two pads which fit over the base of the first metacarpal and the trapezium. The pads are so placed that the extensor tendons pass between them, and the strap is held in place by another strap which passes around the thumb, which in itself tends to favor the reposition of the base of the metacarpal by holding the thumb in the abducted position. The effect of such a strap upon the position of the bones, and especially in the relation of the first metacarpal to the trapezium, is well shown in Figure 8. The restoration of the position of the scaphoid with reference to the os magnum is clearly shown. Before the strap was applied the first row of carpal bones was so flattened that the scaphoid fell away from the os magnum, carrying with it the trapezium and the trapezoid, and, consequently, the thumb and index finger. With the strap in place the flattening of this first carpal row is corrected and the scaphoid is drawn up into place so that it rests firmly against the os magnum with the index finger and thumb in their normal relation to the rest of the hand.

In the severe cases it is necessary, at times, to manipulate the bones to replace them and to hold them temporarily in fixed dressings, these being gradually discontinued, with exercises and the lighter supports later on substituted. If as a result of disease it becomes necessary to allow a stiff joint at the first carpo-metacarpal articulation, care should be taken that the first metacarpal is fully replaced so that proper approximation of the thumb to the ball of the other fingers becomes possible.

OPEN REDUCTION OF AN OLD CONGENITAL HIP DISLOCATION.

BY MAURICE A. BERNSTEIN, M.D., CHICAGO, ILL.

THE manipulative, or so-called bloodless method of reducing congenital dislocation of the hip-joint, has held the field since 1897, when Lorenz[1] and Paci[2] accomplished their first successful reduction. Although the manipulative method has, in a fair percentage of young children, given excellent results, one is never certain of a perfect anatomical reduction, and the injury to the soft structures, and possible fracture of the femur (an accident not uncommon), makes the procedure quite formidable. Moreover, its results are doubtful, or poor in many cases; unsatisfactory in a great number of bilateral cases; and not applicable in young adults. The open method of reduction is in these cases the only hope, and even Lorenz and Bradford, determined advocates of the manipulative method, have devised a plan for open reduction of the intractable cases.

Recent literature shows that the pendulum is beginning to swing toward the open method, and there seems to be a feeling that with an improved technique, and more experience with the open reduction, a method will be evolved which will be superior to the "blind" bone-setting method of manipulation. There will always, however, be a large number of cases that will yield to the closed method of correction, and manipulative reductions should first be attempted, but the open method will be resorted to in a greater measure than heretofore.

It will be of interest to give a brief review of the subject:

The modern surgical treatment may be said to have commenced with Pravaz[3], who in 1838 supplemented the old and only method of treatment by extension, abduction, and pressure of the great trochanter. This method was later revised by Buckminster Brown[4], and Adams[5] published an important paper, with case illustrations, in 1895. Roser[6] did a successful resection of the head of the femur for the condition in 1874, which Reyher[7] repeated in 1882. Koenig[8] detached a periosteal flap from the great trochanter and neck of the femur, turned it upwards, placed the head of the femur in contact with the ilium, and stitched the flap firmly to the head. A variation of this method was

devised much later by Tubby[9], who drilled a hole in the head of the femur, and passed three stout silk strands through it; these were carried through the periosteum of the iliac bone as near as possible to the normal acetabulum, and the ends tied. Thus the head of the femur was sutured to the iliac bone. In 1884, Margary[10] advanced the open treatment by his method of excavating a new acetabular cavity behind its usual position, and in the following year Ogston[11] formed a new acetabulum above the normal position. Poggi[12], in 1888, was entirely successful in a case where he excavated the acetabulum by Margary's method with some modifications. Witzel[13], and others, endeavored to nail the head of the femur against the iliac bone to obtain a point of support and create an obstacle to the upward displacement of the head. The shortening was first corrected by strong traction, and windows were cut in the plaster cast over the great trochanter, an oblique incision was made over the great trochanter through which the nailing was done. Kirmisson,[14] since 1900, has practised a similar method, using ivory pegs.

The various methods mentioned had, however, a very limited application, and in the year 1890, when Hoffa[15] described his operative method, attempts at surgical reduction were nearly always futile. In this year Hoffa did his first successful operation, which consisted in deepening the acetabular cavity by scooping out the contained fat, synovial membrane, articular cartilage and bone. Hoffa made an oblique incision from the anterior superior iliac spine downward and backward over the great trochanter, exposing the joint between the gluteus medius and minimus muscles. In approaching the joint, the tensor fascia femoris, sartorius and rectus femoris were severed. All the muscles attached to the greater and lesser trochanter were also severed and the capsule opened. Hoffa's method was not new, as it was used by Margary and Poggi before him. This method has since been tried by others and proved unsuccessful because the trauma to the joint produces ankylosis.

Lorenz[1] operated according to Hoffa's method in 1892, but he subsequently modified the method by omitting severing the trochanteric muscles and by approaching the joint by an incision from the anterior external surface. This has been termed the Hoffa-Lorenz method.

Bradford[16], in 1905, incised the capsule, dilated or cut the constricted portion or neck of the capsule, replaced the head of the femur and stitched the capsular flaps in such a manner that when cicatrization took place a new cotyloidean ligament was formed so as to hold the

FIG. 1.—Roentgenogram of the hip-joint taken before operation, showing the head of the femur high up on the ilium. The rim of the acetabular cavity can be made out definitely on the roentgenogram. The head is of good form and bears the normal relation to the neck.

head of the femur in place. This method, in a measure, corresponds to the one employed by Galloway[17], who opens the capsule and dilates the constricted portion. Galloway points out that it is impossible to pass the head of the femur through the constricted, narrow capsule by the blind method. Clark[18] opens the capsule at the lowest point of its posterior surface, and the periosteum and cotyloid ligament are detached for about one-half inch at the upper posterior border of the acetabulum. Three stitches are passed through the periosteum into the joint cavity under the cotyloid ligament, then out of the joint and through a fold of capsule and tied. These stitches take up the slack in the posterior portion of the capsule and hold the cotyloid ligament over the outer part of the head of the femur. Tubby[10] opens the capsule

FIG. 2.—Roentgenogram of the hip-joint taken after operation, showing the head of the femur in the acetabular cavity. The limb is slightly abducted.

by a crucial incision over the head of the femur. The constriction is overcome and the head replaced. Albee has introduced an entirely new method of obtaining retention of the reduced hip in a shallow acetabular cavity. The posterior superior lip of the acetabulum is pried downward and outward to overhang the head of the reduced femur and prevent it from slipping up. The piece of acetabulum is held in place by a wedge-shaped piece of bone obtained from the tibia. The method has recently been modified by Fordyce Jones.[20]

The case which I wish to report here is a congenital dislocation of the hip-joint in a girl twenty-one years of age, who was operated on at Michael Reese Hospital, February, 1921. The dislocation was no-

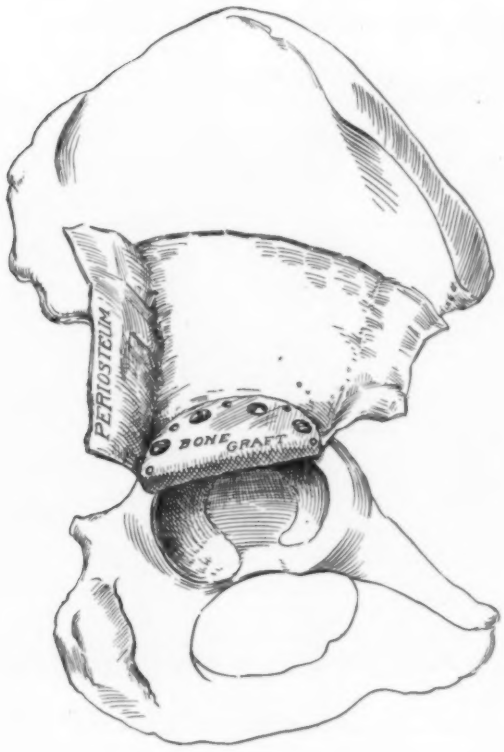

FIG. 3.—Illustration of the bone graft over the superior border of the acetabular cavity when the outer lip is poorly developed. The bone graft is taken from the crest of the ilium and is shaped so that it corresponds to the outline of the acetabular cavity. The reflected portion of the periosteum is sewed over the graft together with the muscles that are attached to it.

ticed when she first began to walk, but no effort was made at that time to reduce the deformity. On examination it was found that she had four inches of shortening of the left leg, walking, therefore, with a marked limp and considerable discomfort. There seemed to be no stability of the hip-joint, and she was distressed when she made a mis-step. She was determined that something be done to correct the deformity, although she was advised by others as well as myself that the operation was of a serious nature, and that the outcome would be uncertain.

On examination of the x-ray plates (Fig. 1), it was seen that the head of the femur was displaced high up on the ilium; it was well formed and bore the normal relation to the neck, so that there was no

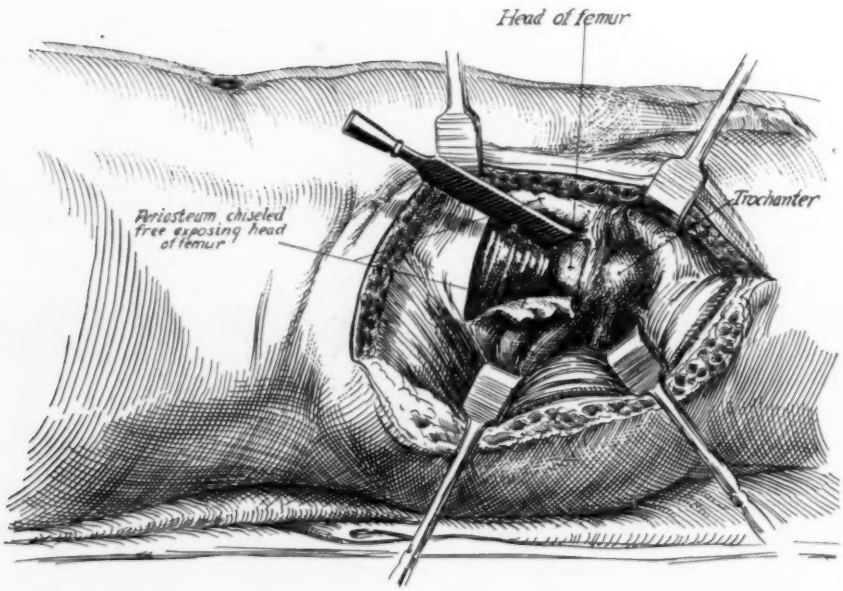

FIG. 4.—Drawing showing the Smith-Petersen incision. The muscles are retracted and the head of the femur exposed and found on the iliac bone.

coxa vara present. The acetabular cavity presented a very good outline, and seemed of fairly good depth. It appeared, therefore, that if the head of the femur could be brought down and placed in the acetabular cavity it could be made to stay there without much difficulty.

Before attempting this operation I had planned a method which I developed upon the cadaver, to be applied in congenital dislocation of the hip, where the acetabular cavity is shallow. This method consists in removing a portion of the outer lip of the iliac crest, placing it over the upper lip of the acetabular cavity, and fixing it there by means of bone screws. The bone transplant is to act as a shelf to prevent the head of the femur from slipping out after reduction (Fig. 3).

I did not employ this method upon this patient, since the acetabular cavity was of good depth.

The usual preparations of the extremity were made and the patient placed upon the Hawley table without traction. The incision employed was the Smith-Petersen[21], which is as follows (Fig. 4):

The incision begins at a point about three or four inches below the anterior superior iliac spine, and is carried forward following the outer border of the sartorius muscle to the anterior superior spine. It is

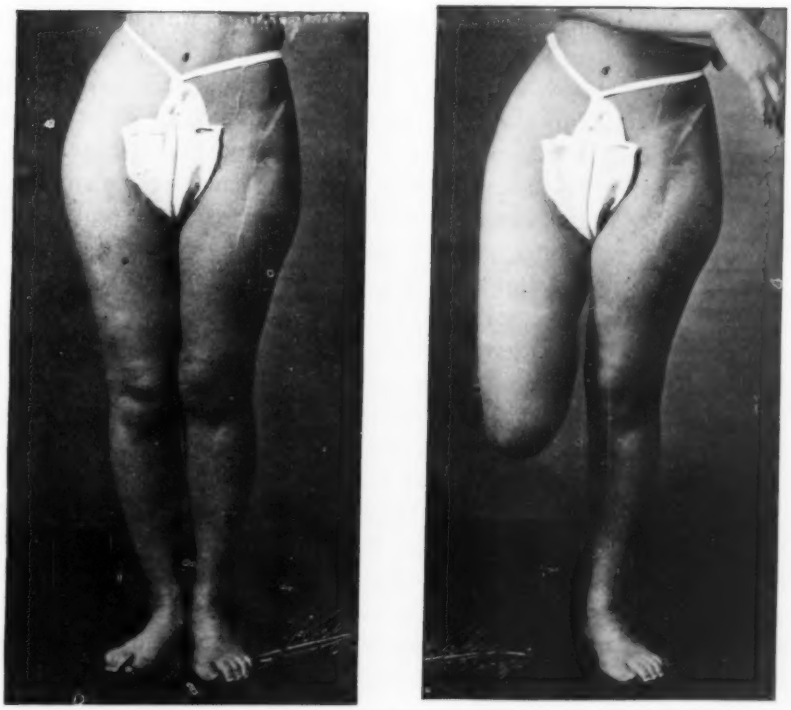

FIG. 5.—Photograph of patient taken five months after operation. The scar indicates the line of incision. The dimpling of the skin is due to a superficial infection. There is motion of the hip-joint in every direction. In the picture to the right the patient is seen standing upon the operated extremity. There is no shortening by actual measurement.

curved backward, following the crest of the ilium for a distance of about two to four inches. The line of incision can be seen from the scar in the photograph of the patient taken after the operation (Fig. 5). The gluteal muscles were then readily stripped down, with the periosteum of the ilium adhering to them, leaving a wide exposure of the hip-joint. The attachment of the rectus muscle at the anterior superior iliac spine was sectioned, so that the tension at the hip-joint was partially overcome. The head of the femur was now easily felt with the finger, and appeared normal in outline. The capsule of the joint was incised, exposing the femur, which was small and somewhat pear-shaped. The capsule was very much elongated and constricted, so that it looked like an hourglass. With a chisel the surrounding tissue and periosteum at the ilium where the head was fixed were stripped as far down as the upper surface of the acetabulum, carrying the

capsule and femoral head downward. An attempt was now made to replace the head into the acetabular cavity, but it did not yield.

Traction was applied with great force and the head was brought opposite the acetabular cavity; it seemed impossible to effect the reduction of the head over the outer rim of the cavity. The posterior portion of the capsule had to be sectioned as it gave considerable trouble in following the head of the femur. Having with great effort replaced the head in the cavity for about half its circumference, complete reduction was finally effected as follows: A few thicknesses of gauze were placed over the great trochanter, with the head partly retained in the acetabular cavity; then the head was driven further into the cavity by hammering gently but firmly on the great trochanter. The object in view was twofold: first, to avoid scraping or breaking down the acetabular contents with a sharp instrument and thus produce a later ankylosis; second, if the head could not be retained by the usual method, it could be impacted into the acetabulum. The head, however, entered and remained there. The rent in the capsule was sewed and overlapped so that a reefing was accomplished. The capsule was also sewed with heavy kangaroo tendon to the outer lip of the acetabulum. The muscles surrounding the joint were sutured in place, and the skin was closed with plain catgut. The limb was put in plaster of Paris in extreme abduction.

The postoperative course was stormy. The patient had considerable pain, and became hysterical, almost maniacal, and continued so for some time. No sedative was strong enough to combat the apparent pain. She was seen by several neurologists, who were of the opinion that the girl was impressed with the seriousness of the operation to such an extent that it brought about an hysteria. I injected the sciatic nerve and also the sacral canal, but there was no relief. There was no pain at any time over the hip-joint itself. The pain was in the ankle and along the outer side of the leg, along the course of the external popliteal nerve.

X-rays were taken after the operation and showed (Fig. 2) the limb in good position, and the head of the femur in the acetabular cavity. Eight weeks after the operation the cast was removed, and it was found that there was free motion in every direction of the hip-joint, and that there was no pain on moving the leg. There was some anesthesia and areas of analgesia of the skin around the leg and also a loss of reflex. There was present a distinct foot drop. All these symptoms, however, cleared up, and the patient now walks with but

little distress or discomfort, using a cane. She is able to walk up and down a flight of stairs, and is able to flex and extend the ankle, but has little power as yet in her thigh muscles, which have become more or less atrophied from disuse.

COMMENTS.

The capsule was found elongated and folded over the head of the femur like a sleeve. When the femur was everted the capsule was found enormously long. A constriction was found about an inch below the head of the femur. When the capsule was incised the constriction did not permit the entrance of the little finger. The posterior portion of the capsule did not permit the reduction of the head since it blocked the acetabular cavity, and followed the head at each attempt at reduction.

The acetabular cavity was well formed, having a sharp upper surface and well-developed outer lip. The cavity was subdivided into two compartments, a superficial one large enough to admit part of the head of the femur, and a deeper one much larger, slanting backward and upward. A ridge of bone separated the two, and was easily broken down in the process of forcible reduction so that the two cavities were joined into one.

Nerve injuries: As a result of traction and tension, injury resulted to the lumbo-sacral plexus. The injury was principally to the origins of the anterior crural and external popliteal nerves. Both these nerves have a posterior origin from the lumbo-sacral plexus. The anterior crural has a higher origin; it arises in the substance of the psoas major muscle from the back of the second, third, and fourth lumbar nerves. The external popliteal arises from the posterior part of the sacral plexus from the fourth and fifth lumbar, first and second sacral nerves. The anterior crural has a more superficial course in the pelvis, passing downward in the groove between the psoas and iliac muscles, and therefore subjected to greater trauma.

SUMMARY.

The difficulty in reducing a congenital dislocation of the hip-joint increases with the age of the patient. The chief difficulty in reducing a luxation by the closed method is the inability of passing the head of the femur through the narrow neck of the capsule. This has been

recently emphasized by Galloway. When the head is once reduced it can be retained by the usual method. In older individuals the depth of the acetabular cavity and shape of the head of the femur are not the chief considerations for a successful reduction. Shortness of the soft structure, muscles, nerves, and blood-vessels are great obstacles. At the age of fifteen or twenty, the muscles, nerves, and blood-vessels have become normal for that individual, and to overcome shortening of four or five inches is a great task. It is therefore necessary to sacrifice muscular attachments. In performing this operation one should first inject the sacral canal to overcome the distressing pain from nerve stretching. One must also take particular care not to injure the blood-vessels. In our case there was no evidence of circulatory disturbance.

I wish to thank Dr. Edwin W. Ryerson for valuable assistance and suggestions in connection with this case.

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FURTHER OBSERVATIONS UPON USE-DESTRUCTION IN JOINTS.

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WHEN I came upon the first specimens of surprising destruction consequent upon use in the shoulder-joint, described in 1915, I quite naturally tried to account for them by assuming that they proceeded from pathogenic causes. I soon realized, however, that such an assumption involved insuperable difficulties, and hence indicated my doubt in the title of that article. However, since the destructions there recorded were so extensive, I was, in spite of my doubts, unable to give a satisfactory explanation for them upon any other basis. Nor could I believe at that time that pathologists or orthopedic surgeons had not already observed and described these startling destructions. The many events in the life history of an individual which remain unknown, especially to the anatomist, and a lack of sufficient experience of pathologic conditions, no doubt, have been largely responsible for failure to recognize the true significance of these and other destructive changes met with in the dissecting room and reported in 1915 and 1920.[1, 2]

The evidences of what I have come to regard as purely functional destructions are too numerous to escape the attention of anyone who carefully follows routine student dissections, but it is easy to attribute them to arthritis and to leave it at that. Perhaps there also has been a feeling that the dissecting room could offer nothing new. Yet, it is exactly here that the minutest necropsies are made; although, to be sure, whether or not the opportunity can be utilized to the fullest extent depends upon many considerations, but mainly upon a knowledge of gross pathological changes by the anatomist.

Since the publication of the first six cases eight years ago, I have paid particular attention to articular changes which do not seem to have resulted from infectious conditions. I fully realize that whether or not changes found in a particular cadaver have or have not resulted solely from an infectious process may be difficult or impossible to de-

termine, but in the course of a decade the evidences have become so abundant and the testimony offered by them so unequivocal, that I no longer can entertain the least doubt regarding the true significance of the changes in question.

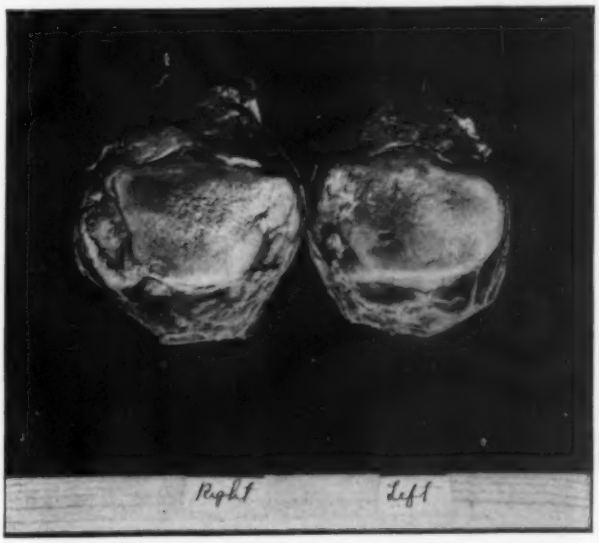
Every one is familiar with the erosion of the skin of the palms of workmen and with the evidence of wear on the permanent teeth shown in such marked degree, especially in many Indian skulls. The well-known effect upon the teeth of the persistent use of a pipe is a related phenomenon, and other more infrequent instances of what may be termed use-erosion upon the external surfaces of the body easily will come to mind. A few individuals outside the rank of anatomists also may be familiar with the relation between the degree of wear in teeth and certain correlated asymmetries of the mandibular condyles and the glenoid fossae of the skull.

It must not be overlooked, however, that it is necessary to discriminate between erosion which is truly functional and that which is only incidentally so. The teeth during mastication, for example, are worn directly through use. The skin and hair, on the other hand, are worn indirectly through use of a part which they happen to cover. However, the bursae in question here are destroyed directly through use made of them in the movements of a part with which they are related, and the same thing holds for the ligaments and joint capsules involved. The tendons concerned also are destroyed in this active manner through direct use in the execution of movements which are effected partly or at least influenced by them. Yet it is important to note that these tendons and ligaments do not suffer destruction directly from the tension made upon them by the contraction of the muscles to which they belong, but through contact with bony surfaces with which they happen to come in contact in the course of movements. Hence in the last analysis their destruction, too, is incidental and indirect. In case of the cartilages concerned, however, the destruction is a directly functional one, for they are worn away while playing the rôle for which they would seem to exist.

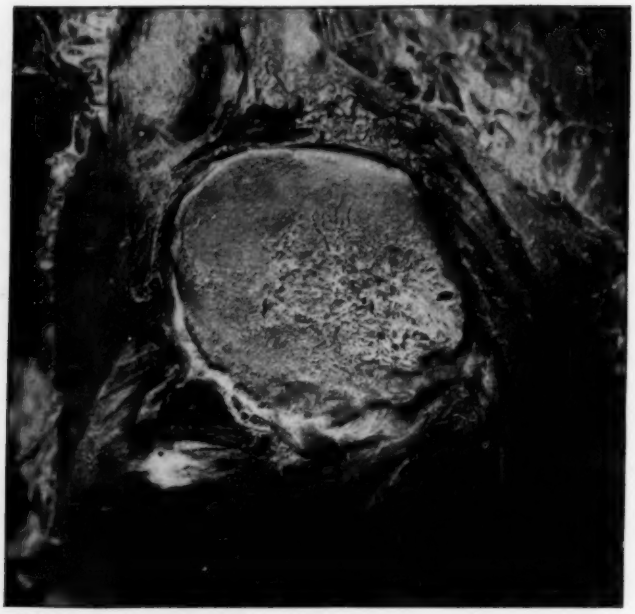
It has been a time-honored belief that the articular cartilages do not wear from use alone and that defects in them are always due to traumata or to arthritides. Yet it is not uncommon to find that the articular discs in the temporo-mandibular articulations may be destroyed almost completely through use. I say this in spite of the fact that, as generally assumed, these discs may rarely be defective developmentally, for the contrast between those from young adults and oc-

togenarians is very striking. The conditions referred to in these discs cannot be attributed to simple atrophy, that is, to senility itself, for any lack in vigor in the use of the muscles of mastication because of advancing years would seem to be compensated for by a more prolonged, even if a more inefficient, mastication. Moreover, the proverbial greater loquacity of old age would also tend to counterbalance any deficiency in the use of the mandible due to other causes.

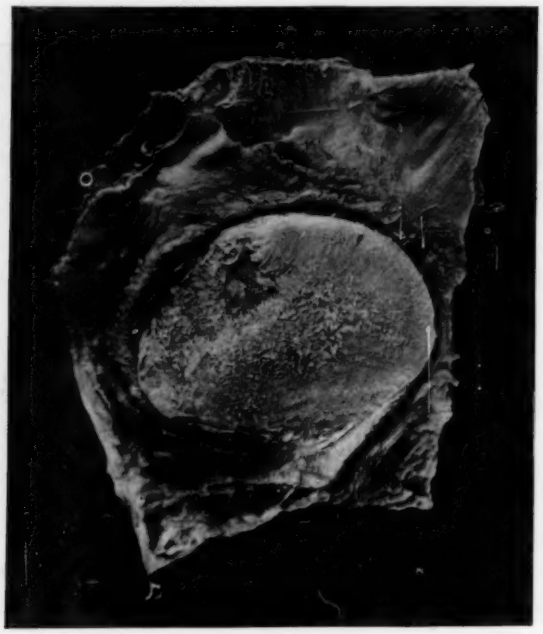
But the internal effects of use are not limited to these or to other interarticular discs, for not infrequently the fibro-cartilage over the mandibular condyle is reduced to a very thin layer of extremely hyaline, fibrous connective tissue containing nothing but a few remnants of nuclei. Moreover, it may be eroded completely in certain areas of contact. Since these destructive changes have been noted in temporomandibular joints, the articular capsules of which appeared wholly normal, it hardly seems as though one can rightly attribute them to infectious processes, particularly not since wholly comparable instances of erosion of articular cartilages with polishing of the underlying bone occur not uncommonly also elsewhere. I have seen a number of such instances in the phalanges of both hands and feet and also in the carpals and tarsals. Since articular cartilages are regarded as especially resistant to infectious changes, it would seem that infections, if of sufficient duration to result in complete destruction of the cartilages,



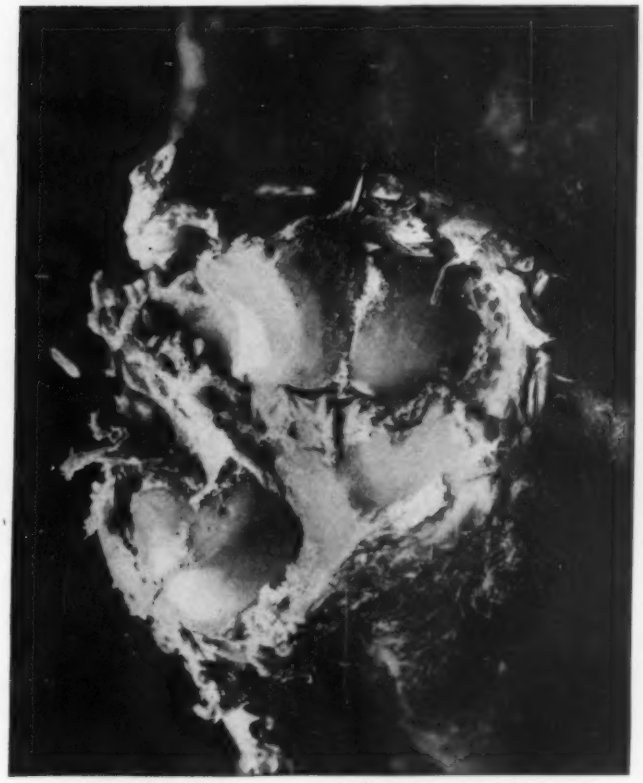
(1) Slight roughening of the cartilages on patellae from a man of 64 years.



(2) More pronounced roughening of the cartilage upon the left patella from a seaman of 83 years.



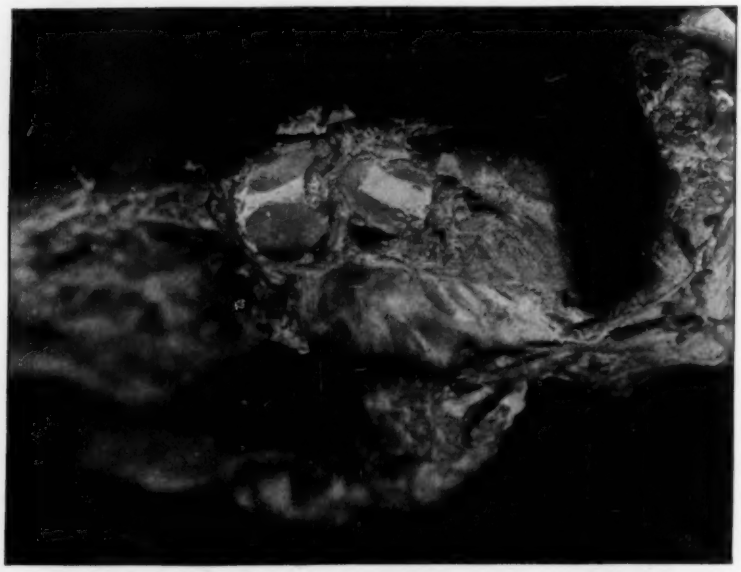
(3) Similar but still more pronounced changes upon the patella from a housekeeper of 74 years.



(4) Marked erosion upon the distal extremity of the ulna and lunatum from a seaman aged 83. The lunatum is reflected distally with the capsule.

surely would result in a considerable thickening of the articular capsule and necessarily would produce other easily recognizable structural changes, as well as symptoms and signs of arthritis.

It is a very common thing to find undoubted evidence of wear on the sagittal ridge of the patella from wholly normal knee-joints. All grades of wear can be seen in otherwise wholly normal joints from the slight roughening shown in Figure 1, to the more marked changes shown in Figures 2 and 3, even to complete erosion of the cartilage over certain areas with polishing of the underlying bone. The same thing holds for the distal extremity of the ulna, the styloid process of which not rarely is polished from contact with the triquetrum and may even be completely destroyed by the erosion. Similar phenomena are found on the distal extremity of the radius also. An exceptionally fine example of complete destruction of the fibro-cartilage on the distal ex-



(5) Complete erosion of the articular cartilages with considerable destruction of bone and exquisite polishing of the pisiform and triquetrum from a housekeeper aged 74.

tremity of the ulna with some erosion of the styloid, the lunatum and head of the ulna through the movements of pronation and supination is shown in Figure 4. The triquetrum does not show well in this illustration but marked erosion is evident upon the periphery of the head of the ulna and upon the corresponding surface of contact of the lunatum. Although the fibro-cartilage was completely destroyed in this case, no evidences of arthritis were present.

That use alone can result not only in complete destruction of the cartilages but in considerable destruction of bone also is splendidly illustrated by several instances of wear between the pisiform and triquetrum, such as represented in Figure 5. Although this joint was otherwise entirely normal, not a particle of the articular cartilage was left upon the surfaces of contact between these bones. Furthermore, considerable amounts of the entire articular surface of both bones had been removed by friction. Yet the coapted surfaces fitted perfectly and were so highly polished as to reflect light like a mirror, as shown in the illustration. Varying degrees of erosion of cartilage and bone are extremely common between these two bones in wholly normal joints, a fact which accords well with the explanation offered here for these changes.

(6) Lateral view of the right shoulder joint with deltoid reflected, from a sailor aged 64. Note especially the thin, opened subdeltoid bursa, the small capsular defect and the slight fraying of the external surface of the articular capsule.

Similar though less complete effects of erosion are shown also in the shoulder-joints described in the above articles. Although the articular cartilages, both on the humeral head and in the glenoid cavity of the scapula, are wholly normal in some of these joints, they are completely eroded over considerable areas, with polishing of the underlying bone in others. The presence of an infectious process as a primary cause for these changes can be excluded with considerable certainty, for the minor secondary changes noticeable in the surrounding soft parts and in the adjacent bone in some specimens could result from non-infectious, inflammatory changes resulting from the trauma incident to the excessive use which caused the destruction.

(7) The left shoulder joint from the same case. Note especially the clean-cut outer margin of the coraco-acromial ligament and the small bony excrescences in the capsular defect.

Since most of the twenty cases of partial or total destruction of the superior portion of the humero-scapular articular capsules were characterized also by destruction of the subdeltoid and subacromial bursae, I thought it not improbable at first that the destruction of these bursae usually is the first step in the destructive changes in the shoulder-joint previously reported. Very recently, however, I have come upon arms in which these bursae, if originally separate, had fused and become considerably enlarged. All these bursae had very thin normal walls adherent to the acromion and all extended distally over the humeral tuberosities. Yet the region of the latter and the inferior surface of the acromion showed clear evidences of friction in the fraying of the soft tissues which cover them. Moreover, the joint capsules were locally deficient in several of these arms, two of which were from the body of a "sailor," another from a "seaman," and several from

(8) Anterior view of the right shoulder joint from a seaman aged 83, showing a large anterior capsular defect, the upper portion of which is bounded by the exposed, slightly-frayed portion of the tendon of the long head of the biceps, the superior humero-scapular ligament and the adjacent portion of the articular capsule. Note the fraying and the second defect, shown in the next figure, at the top of this illustration and the clean-cut margin of the coraco-acromial ligament.

housekeepers. The triangular defects in the capsules of the paired arms shown in Figures 6 and 7, were located directly cranially to the greater tuberosity and measured 5 x 15 and 4 x 7 mm., respectively. Both defects slightly involved the anterior border of the tendon of the supraspinatus near its insertion, but the remainders of the superior portions of the capsules and the entire articulations were but slightly affected. The anterior margin of the coraco-acromio ligament of the left arm, shown in Figure 7, was worn to a knife-edge, and areolar tis-

(9) Superior-lateral view of the same specimen, showing the upper capsular defect with the humerus in internal rotation. Note the thin, well-defined margin of the tendon of the supraspinatus located dorsally to the defect, and the thin reflected subdeltoid bursa.

sue and the fibrous expansion ordinarily extending from the tendon of the coraco-brachialis to this ligament had been worn away completely.

The superior portion of the capsule of the shoulder-joint of the right arm from another cadaver contained two larger defects, one lying on either side of the tendon of the biceps which still was covered by the narrow adjacent strip of capsule, including the superior glenohumeral ligament. The anterior defect is shown in Figure 8, and the lateral in Figure 9, in which the deltoid and the wall of the subjacent bursae are reflected. The anterior margin of the tendon of the supraspinatus which forms the dorsal boundary of the latter defect not only is entirely exposed but is worn to a fine edge. The tendon of the biceps which forms part of the dorsal border of the anterior defect is exposed and frayed, its synovial sheath having been worn away by contact with the acromion in external rotation and abduction. The soft tissues on the under surface of the coracoid also were frayed.

The fraying of the entire dorsal surface of the joint capsule in this

(10) Dorsal view of the same shoulder, showing the reflected bursal wall and marked fraying and trabeculation of a bursal septum.

shoulder is well-shown in Figure 10, in which the effect of wear is seen also upon the internal surface of the reflected deltoid near its acromial attachment. This figure also shows marked fenestration of a thickened dorsal septum in the subdeltoid bursa, the thin outer wall of which has been partly reflected. This is entirely comparable to similar findings in the interbursal septa in the prepatellar and the olecranon regions, described in a former article (Meyer, 1920). In spite of these pronounced effects of wear in the capsule and bursa, the tendon of the biceps, which is shown in Figure 11, is in a still earlier stage of division from contact with the greater tuberosity than that represented in Figure 3 in the above article. Evidences of wear of the soft parts are present also upon the inferior surface of the acromion, but the articular cartilages are wholly unaffected and no bony polishing is present.

(11) Internal surface of the tendon of the long head of the biceps from the same case. Note the fraying of the tendon and the reflected, normal synovial sheath in the distal (lower) portion of the tendon.

(12) Lateral view of the right shoulder joint from a housekeeper aged 74, with the deltoid reflected upward. Note especially the small capsular defect and the fraying of the capsule.

(13) The tendon of the biceps from the same case with the scapular attachment to the left. Note the slight fraying to the left of the middle and below on this tendon.

(14) Anterolateral view of the left shoulder from a housekeeper aged 74. Note the bursal defect and the fraying of the underlying capsule.

Similar conditions exist also in the shoulder-joint from a "housewife" shown in Figure 12. In this shoulder the capsule also contains a small defect and is frayed very remarkably, although the large subdeltoid bursa was intact and very thin-walled. The tendon of the biceps of this case was frayed only very slightly, as shown in Figure 13, for the small capsular defect did not permit the greater tuberosity to come into free contact with the tendon.

The first two of these arms, in which the cartilages of the shoulder-joint also were entirely normal, represent the earliest stages in the formation of capsular defects which I have seen, but they do not exemplify the earliest stages in this process of joint destruction. These are represented by instances in which only the external surface of the articular capsule or the external surface of the subdeltoid bursa is frayed slightly. The left shoulder-joint shown in Figure 14 shows a fairly early stage, for in this case the wall of the subdeltoid bursa only was destroyed. It may also be noted that the outer wall of the subacromial portion of the subdeltoid bursa, or that of the subacromial bursa itself when present as a separate sac, apparently becomes firmly adherent to the inferior surface of the acromion process in these cases. After becoming adherent the subacromial portion of the bursal wall then is destroyed by being ground against the acromion.

All tendons of the biceps shown here are in early stages of division, no doubt because the defects in the articular capsules are so small. It is evident that as soon as these defects become large enough to permit the greater tuberosity to pass into the articular capsules, when the arm is brought into a position of marked abduction, it enters the joint cavity and comes into free direct contact with the tendon. The rate with which abrasion of the tendon of the biceps then occurs depends, no doubt, upon the exact use to which the arm is being put. If the arms from which these tendons were taken are abducted so that the greater tuberosities of the humeri pass through the defects in the upper capsule, then the coracoid processes pass directly over the anterior capsular defects. But these defects do not result from contact with the coracoid, for quite contrary to the greater tuberosity, which frequently is polished from contact with the inferior surface of the acromion, the corresponding surface of the coracoid never was found polished. This, no doubt, is due to the fact that bony contact between the region of the tuberosities and the coracoid does not normally occur.

The only instances of bony erosion of the coracoid which I have seen came from the cadaver of a woman who died from a pronounced cancer

(15) Anterosuperior view of the left shoulder joint from a sailor aged 69. Muscles removed to show the complete destruction of the upper half of the capsule and the perfect preservation of the cartilages.

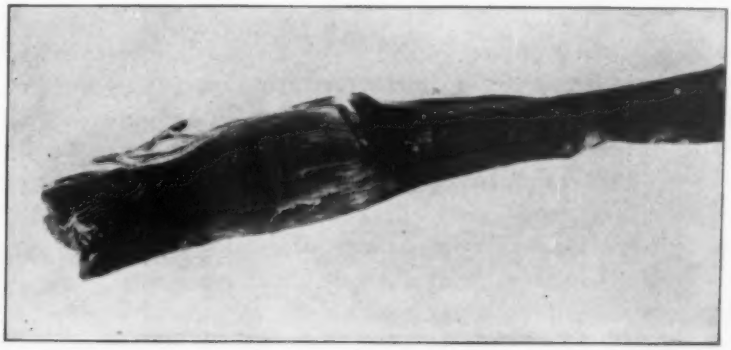
en cuirass some time after ablation of both breasts. Since the neoplasm had invaded the pectorales as well as metastasized to the heads of both humeri, it is highly probable that muscle spasm and contractures were responsible for approximation of the humeral heads to the coracoids in this case. Moreover, it was very clear that the coracoids, which had been reduced to less than half their normal thickness, were not worn down through contact with the humeral tuberosities but through contact with the heads of the humeri. Hence, although the external surface of the articular capsule may become worn in its anterior portion merely by being folded between the coracoid and the region of the anterior tuberosity, capsular defects probably do not result in this way. That this actually is the case is suggested not only by the fact that the defects located in this portion of the capsule are produced by contact with the acromion in a position of external rotation and abduction of the arm but also by the fact that only the soft tissues on the inferior surface of the coracoid are frayed in these cases.

(16) Superior view of the left shoulder from the same case, with deltoid reflected, illustrating the same things.

That very extensive destruction of the capsule of the shoulder-joint may occur without any change in the articular cartilages is exemplified very well by the shoulder-joints of a sailor shown in Figures 15 and 16. In both these joints the entire superior half of the capsule and the tendon of the biceps were destroyed and the internal surface of the acromial portion of the deltoid frayed. Yet the articular cartilages are well preserved and no bony or other changes at all suggestive of arthritis are present. But the best example of early functional destruction that I have so far observed is the capsular defect in the left hip-joint from a gardener, shown in Figure 17. This defect, which measured 2.2 cms., is contained in an otherwise wholly normal joint. It was covered by the broadest portion of the tendon of the ilio-psoas shown in Figure 18 and apparently was produced by contact of this portion of the capsule with the periphery of the femoral head which is slightly rough at the border of the cartilage in all normal bones.

Even if one recalls that the articular capsule of the hip-joint frequently contains a bursa in the region of this defect and hence is likely to be thinner, one cannot ignore the effect of friction. This is true even

(17) Anterior view of the left hip joint from a gardener aged 53. Note the extensive capsular defect, the thin margin of the latter and the fraying.



(18) The tendon of the ilio-psoas from the same case with the proximal extremity to the left. Note the slight fraying at the widest portion of the tendon.

if such a bursa, if present in this case, communicated with the joint cavity or even if an actual development defect was present in this capsule. This follows because the margin of the defect is worn to a very thin edge and frayed as shown even in the photograph. Moreover, since the tendon of the ileo-psoas also is worn and somewhat thinner in the area of contact with the femoral head, it is clear how large a rôle friction played in the production of such a capsular defect.

A second instance of a similar defect was observed in a seaman of 64 years. In this case, too, the margin of the defect showed undoubted evidences of wear and so did the internal surface of the tendon of the ilio-psoas. Yet the entire joint capsule and the articular surfaces of the bones appeared wholly normal.

Since I have not seen congenital defects in the capsules of hip-joints in a small series of foetuses near term and of infants which have come under my observation, I have been prompted to surmise that the defects occasionally said to occur in this capsule in adults and which are regarded as variations, possibly all are the result of erosion. Unfortunately, not sufficient material is at hand to enable me to determine this question at present, but if one considers the relation of the margin of the articular surface of the head of the femur to this portion of the capsule in movements of extension and flexion, and the rôle of the tendon of the ilio-psoas, one would be surprised if defects did not result from wear on internal surfaces of the capsule.

The severed tendon of the long head of the biceps in the cases of joint destruction no doubt receives a secondary attachment in the region of the lesser humeral tuberosity, not only because it normally is located upon the anterior portion of the head of the humerus but because of the trauma to which this region is subjected by friction from the acromion. Apparently this tendon may be worn in two places—near its scapular insertion from contact with the greater tuberosity, and in a region directly proximal to the lesser tuberosity, from contact with the acromion. However, the latter contact apparently never was sufficiently intimate in any of these cases to nave resulted in division of the tendon in this region.

Until I had observed more specimens I was unable to satisfactorily explain the genesis of the secondary attachment of the tendon of the biceps. That the divided tendon attained its secondary attachment in the region of the lesser tuberosity in consequence of trauma and the inflammatory reaction invoked thereby, seemed very probable, but until the rôle played by the acromion in the production of traumata in

this region was known to me, I was at a loss to satisfactorily account for this secondary attachment of the tendon.

The tendon of the supraspinatus usually is divided only partially but may be markedly dislocated posteriorly together with the adjacent portion of the articular capsule. Rarely, however, it is completely divided and retracted quite independently of the divided portion of the capsule, becoming adherent to the surrounding structures and hence wholly useless. The tendon of the subscapularis also may be partly destroyed and displaced and even that of the infraspinatus may suffer a similar fate.

In several instances observed by me, the erosion of the humeral cartilage is very restricted, but in others the eroded areas are relatively large, although the corresponding area of contact with the glenoid lip may be relatively small. This is due to the fact that the humeral head glides back and forth over the eroded area on this lip. A similar relationship exists between the polished area on the greater tuberosity and that on the inferior surface of the acromion. The latter always is large and may be deeply worn, while the former is relatively small in most cases. In some cases there are two oblong eroded and highly polished osseous areas on the humeral head, which lie in a frontal plane. That nearest the greater tuberosity is produced by contact with the acromion. The one farther distant and lying roughly in the same line, is formed by contact with a small area on the superior glenoid margin. Since the bony polishing of the latter must be preceded by destruction of the resistant fibro-cartilage of the glenoid lip, one can form some conception of the duration of the friction.

Since the inferior surface of the acromion is covered only by periosteum and fibrous extensions from the coraco-acrominal and the acromio-clavicular ligaments and protected further only by the thin wall of the subacromial bursa and interposed areolar tissue, it and the co-apted region of the greater tuberosity naturally show evidences of erosion and polishing first. As reported in previous articles, this erosion may result in almost complete destruction of this tuberosity. Under these conditions there is sure to be considerable abrasion of the acromion and great destruction of the articular capsule and of the included ligaments, so that the acromio-clavicular communicates directly with the humero-scapular articulation.

Since the subdeltoid and subacromial bursae and almost the entire superior portion of the articular capsule and of the tendons of the supraspinatus, long head of the biceps, and partly also those of the

subscapularis and infraspinatus, may be destroyed and the acromioclavicular articulation opened through wear, one is justified in speaking of partial destruction of the shoulder-joint in these cases, and it must be evident that the function of these shoulders must be greatly impaired. This is especially true in all cases in which the deltoid finally must act in place of the upper portion of the joint capsule. When its inner surface becomes frayed by wear from contact with the greater tuberosity the traumatic irritation well may cause spasm of the muscle. These shoulders also must lose greatly in stability because of such extensive destruction as here recorded. Abduction of the arm also must be greatly reduced in power, especially at the beginning of the movement, in cases of destruction of the tendon of the supraspinatus. Supination of the forearm should be greatly reduced in power, for a time at least, in all cases in which the tendon of the long head of the biceps fails to obtain a secondary attachment before division of it, for this would permit considerable relaxation of the outer belly of this muscle. Whether or not such an antecedent attachment is gained will depend, no doubt, partly upon the exact location of the destructive process,—that is, upon the particular use to which the arm is being put, and upon the reaction evoked in the traumatized tissues. Failure to secure such an antecedent attachment also would result in asymmetry in the contracted biceps.

That the destruction wrought in these shoulder-joints is not due to infectious processes is established conclusively by the fact that the inferior half of the capsule always is found to be entirely normal in thickness and appearance and also by the entire absence of adhesions outside the immediate area of the destruction. No matter how much erosion the external surface of the superior portions of the capsule showed, the internal surface invariably was smooth and normal in all respects and the same thing was true of the internal surface of the inferior portion of the capsule in cases of complete destruction of the superior half. Since the articular cartilages also were wholly normal, in many cases showing extensive destruction of the tendon and capsule, infectious processes can be excluded with certainty.

Such secondary changes as the attachment of the severed tendon of the biceps and the presence of small bony excrescences in the region of the humeral tuberosities, together with calcareous deposits in the divided, retracted capsule, easily could accompany such extensive traumatism, or arthritis may co-exist. However, since not a trace of hemorrhage or of coagulum was found in any of these—over a score—arms, any sec-

ondary infectious process which may have been present must of necessity have remained non-suppurative and hence incapable of such extensive destructions.

Effusion, pain, and limitation of motion no doubt are present over a considerable period of years in all these shoulders and it does not take much imagination to surmise that they probably were regarded as rheumatic or arthritic. Since the traumatic destruction of the soft parts, even if gradual, was so extensive, one cannot doubt that non-infectious, inflammatory reactions must have been present and that, in this sense, arthritis really was present in these joints. Moreover, it does not seem improbable that some, if not many, of the cases of subdeltoid bursitis have their origin in irritation from use.

I am unable to say how long a period of time is needed for the destruction wrought in some of these arms, but decades, no doubt, were involved. I never have encountered them in early maturity, although I must add that it is but rarely that we obtain a body from these years. All the specimens observed came from cadavers beyond the fifth decade but this does not presuppose that these changes can be regarded as senile. They no doubt were produced during the most active years of life of these persons, and, in the absence of reparative processes, merely have persisted. However, in some cases these traumatic defects no doubt have been enlarged during advanced years, for some of these individuals were engaged at work in which neither skill nor speed were indispensable factors.

The long period of time involved in these destructions makes one wonder how many bottles of soap, or Sloan's liniment, St. Jacob's or Omega oil these individuals must have used while seeking relief from what they themselves probably assumed was chronic rheumatism. The only relief from these things lies, to be sure, in a change of occupation. Lessened activity or a rest may bring some relief, but neither of them nor a surgical operation can stop the destruction. From the evidence presented here and elsewhere it seems to me that we must give these destructions larger consideration, for it seems undoubted that things which have been assumed to be pathogenic in cause are partly or even wholly the incidental effects of use, or better, of overuse.

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BONE SARCOMA.

BY JAMES W. GIBBON, B. S., M, D., CHARLOTTE, N. C.

It is now more or less generally recognized that there is much variation in the clinical manifestations and relative malignancy of sarcoma involving the bones, and this fact finds rational basis in the pathological diversity of these tumors. Because of this difference in the relative maligancy of types of sarcoma, the problem is very often not so much one of treatment as of diagnosis of the type of tumor with which one is dealing, if proper treatment is to be carried out. The malignancy varies from the rapidly growing, extremely fatal round-cell types to the so-called benign giant-cell or epulis type, with the fibro-sarcoma, myxo-sarcoma, and osteo-sarcoma as intermediary forms. The first is hopeless in spite of any method of treatment in 92 to 96 per cent. of the cases, while the least malignant, giant-cell type, is amenable to cure following so simple an operation as curettage, or at the most, a local resection of the bone. The giant-cell sarcoma never gives rise to metastases, is never fatal, and so benign in its clinical manifestations that some observers do not classify it as a sarcoma at all, but prefer the more descriptive terms of Giant-Cell Tumor (Bloodgood), or Chronic Hemorrhagic Osteomyelitis (Barrie). In Ewing's "Neoplastic Diseases" this lesion is classified among the sarcomata. Apparently the actual pathological position then of the giant-cell sarcoma has not been definitely determined, but the distinguishing feature on which all agree is its relative benignancy, and response to conservative treatment. Occurring in the localities of the rapidly growing, malignant sarcomas, the giant-cell tumor must at all times be differentiated from these, if radical operations for a comparatively benign lesion are to be avoided. Diagnosis, therefore, particularly of this tumor, becomes the great problem. In cases where there is any doubt, an exploratory incision should be made in order to allow a study of the gross form and preparation of microscopic sections of the tumor. The advantages of an exploratory incision for diagnostic purposes are greater than the disadvantages. No direct harm has been found to come from its use, and it may be the means of saving a limb. Even following a method so exact, the diagnosis may remain very obscure in certain cases, and pathologists may

completely differ in regard to the interpretation of the sections, so that, while we do attempt to make a precise, clean-cut diagnosis, there are occasions when this may be extremely difficult or even impossible. As remarked by Ewing, "There is considerable variation in the rate of growth and bone absorption by benign giant-cell sarcoma. As the spindle cells of the stroma become more active and abundant, the giant-cells diminish, the tumor shows less resemblance to granulation tissue, but becomes firmer and like spindle-cell sarcoma. Such growths recur locally, and may destroy bone and infiltrate the soft parts, but I have never known them to yield metastases." (Neoplastic Diseases). The case here reported may possibly exemplify some of the difficulties of diagnosis.

CASE REPORT.

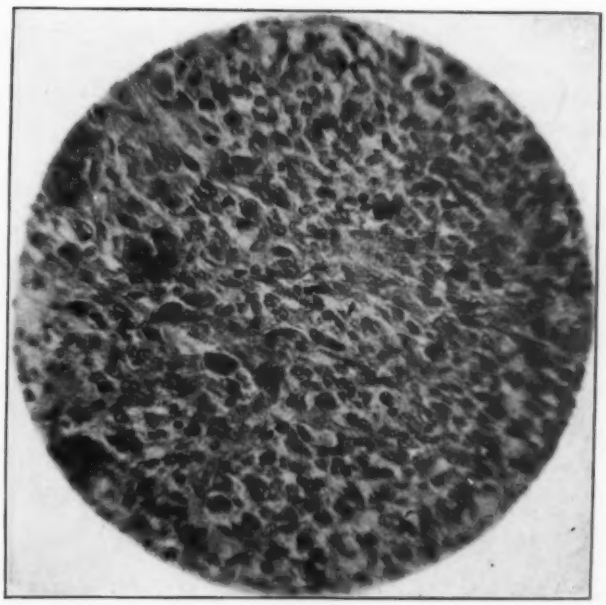
A white male, aged 16 years, complained of pain and swelling just above the right knee, and a limp. The onset was in March, 1921, with pain in and above the knee. There was no previous history of trauma, or symptoms referable to this extremity. This pain at first was very mild, and after two days of rest passed away. A soreness remained in the region, however, and thereafter he limped on walking. About the middle of June, pain again became a symptom, much more severe in character, and gradually becoming worse. The limp also became more exaggerated. The swelling was thought to have started about this time. The pain seemed much worse at night, and kept him awake. On August the first he presented himself for treatment.

On physical examination there were no features worth noting except the local condition. He was a well nourished boy, with a normal pulse and temperature. Local examination showed, above and to the outer side of the right knee joint, a globular swelling. The skin overlying it was blanched, not hot, and contained no enlarged veins. On palpation there was slight tenderness over the tumor, and a sense of softness. There was a small quantity of fluid in the knee joint, but no limitation of joint motion. There was no atrophy of the muscles above or below.

The urine examination was negative, no mention being made of Bence-Jones albumen. The blood Wassermann was negative, the leucocytes were 8,300, and the hemoglobin was 85 per cent. X-ray examination of the lower end of the right femur showed a sharply-defined lesion in the medulla of the diaphysis. There was almost complete destruction

of the compact bone, on lateral aspect the bony shell was apparently broken through, and no expansion of the bone was to be detected. In the periosteum an ossifying periostitis was visible. The epiphyseal cartilage was intact, and the epiphysis not invaded.

A positive diagnosis was made at this time, and on August the second, the lesion in the bone was explored. The cavity occupying the lower end of the femur was large, and filled with soft, dark red, hemorrhagic granulation-like material. The shell of bone was very thin, and to the outer side it had been broken through, and the same hemorrhagic material was infiltrating the soft parts. The epiphysis was not involved and the joint was not broken into. The periosteum was thickened and producing new bone. A gross diagnosis of Giant-Cell Sarcoma was



made, the bone cavity thoroughly curetted, all visible tumor removed from the soft parts, and the incision closed without drainage. A good deal of hemorrhage attended this procedure. The patient made a good recovery, and was discharged on crutches from the hospital on the tenth day, but was to return at regular intervals for observation.

Microscopical examination of the tissue removed showed some little difference in the giant-cell content in different areas. In all sections examined the tissue was seen to consist of closely packed cells lying in a thin, sparse stroma. These cells varied much in size and shape—some were round and some were spindled-shaped. Many mitotic figures could be seen. Between the cells large blood spaces were present, and contained blood. These were apparently large blood-vessels with thin walls, or walls formed only by the tumor cells. In one section as many as 8 to 12 giant-cells of the foreign body type could be seen in one high power field. In other sections these forms were less numerous, but present. There was a difference of opinion regarding the diagnosis from these sections, so some of the tissue was sent to Dr. Bloodgood, in Baltimore, and some to Dr. Crawford, in Philadelphia.

On August 20th, before a report had been obtained from either of these pathologists, the patient came back complaining of a return of severe pain. On examination it was evident that the tumor had re-

curred locally, and was infiltrating the soft parts on the inner side of the knee, where there was a considerable swelling. That this was then a rapidly growing sarcoma clinically seemed to be a just conclusion, and amputation was advised. The parents, however, refused this, and again all of the tumor tissue possible was removed, and the area cauterized with carbolic acid followed by alcohol. The recurrence at operation did seem to be confined to the soft parts, there being no extension up the bone, and no extension into the epiphysis, or invasion of the joint. A great deal of hemorrhage also attended this operation. On September the 14th, the leg was amputated in the upper third of the thigh, a local recurrence having again occurred at about the end of three weeks. X-ray plates of the thorax at this time showed no metastases. Healing of the wound and convalescence was then rapid and the patient was discharged on September the 25th. I have seen the patient several times since. He has gained weight and strength rapidly and is now perfectly well.

The report of Dr. Bloodgood was this: "Although there are some giant-cells there are not many. The tumor is composed chiefly of large round cells of the sarcoma type, some very large cells, some few spindle. It impresses me as a large round-cell sarcoma. Here and there are spicules of bone undergoing destruction. Many large blood-vessels

are present." Of the gross specimen he remarks: "Your description of the gross tumor is that of the giant cell, but there is a sarcoma, fortunately rare, which resembles the giant-cell tumor in the gross, and I fear your tumor belongs to the sarcoma group." Dr. Crawford considered the specimen a giant-cell sarcoma.

The interesting features of this case are: the boy is 16 years old, a very rare age for central sarcoma (Bloodgood); he is now well following amputation almost twelve months after the symptom of onset, and six months after the amputation; the promptness of local recurrences in the soft parts; the marked bone destruction without expansion, and the production of new bone from the periosteum; the resemblance of the gross specimen to the benign giant-cell tumors; and the difference of opinion in regard to the sections. If this is a type of malignant sarcoma, it is of still greater interest because of its resemblance in the gross to the benign-cell sarcoma or giant-cell tumor.

OSTEOMA OF THE CERVICAL SPINE.

BY MELVIN S. HENDERSON, M.D., ROCHESTER, MINN.

Section on Orthopaedic Surgery, Mayo Clinic.

CASE A375531. H. O., a boy, aged ten years, was first seen in the Mayo Clinic, October 21, 1921. The boy's mother gave a clear and concise history of his present illness. September 9, 1921, he complained of a dull ache in the right posterior part of the neck, aggravated particularly by sudden or jerky motions. After three days the pain was so continuous and severe that he was forced to stop school. About this time, slight swelling and tenderness in the region complained of was noted. His temperature varied from 99 to 101. Movement of the neck was greatly restricted and forced movement caused excruciating pain. At the end of a week, as the pain continued, the boy was taken to a hospital and an incision made into the swelling, but no pus was obtained. The surgeon confessed that he was unable to diagnose the condition, but thought it might be deep cellulitis. During the next two weeks the condition was even more aggravated and the swelling increased and extended to the right submaxillary region. Another exploratory incision was made by the same surgeon, and a hard tumor, not clearly outlined, about 4 or 5 cm. in diameter, was encountered, and believed to be in the deep cervical fascia. Specimens removed for examination were diagnosed as nonmalignant fibrous tissue with occasional islands of bone. The swelling did not subside, and the patient continued to suffer greatly from pain and loss of sleep and appetite. He had lost fourteen pounds in weight. Gradually, the pain became less severe, but continued to be persistent and worrisome.

Examination, October 29, 1921, revealed a boy of good physique, but the effects of his suffering were definite. He held his head forward so that his chin was practically on his breast, and in order to look ahead it was necessary for him to bend his knees and throw his spine back of the center of gravity. Examinations of the heart, lungs, kidneys and blood were negative. A thick, hard swelling involved the right upper cervical muscles and extended forward to the right submaxillary region.

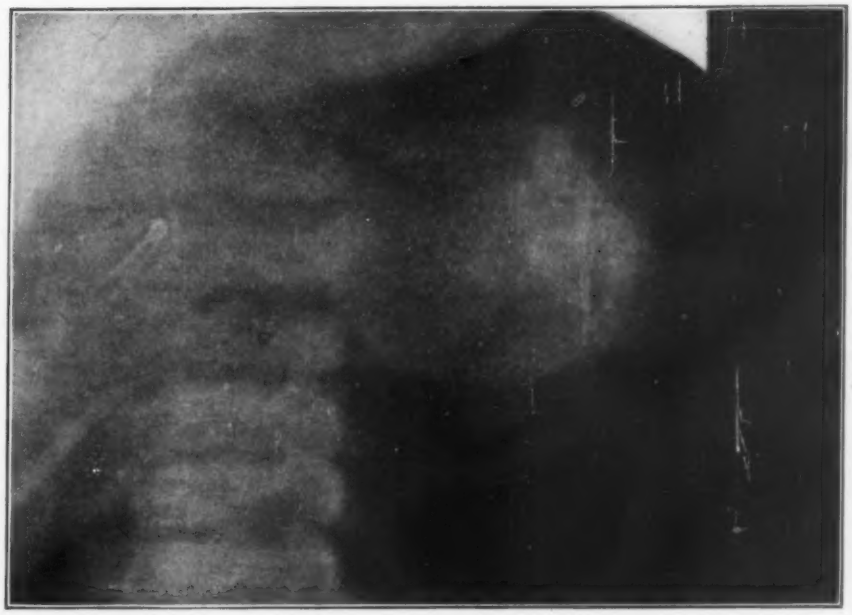


FIG. 1.—(A375531.)—Osteoma of the cervical spine.

A slightly purulent discharge drained from the incision, which was red and inflamed. A globular tumor was detected on palpation, and this finding was substantiated by the roentgen ray, which showed a circular, bony tumor about 5 cm. in diameter (Fig. 1). It seemingly arose from the right side of the third cervical spinous process or, possibly, from the articulating process. A provisional diagnosis of osteochondroma was made.

Tonics were prescribed and the boy was encouraged to go around out of doors. He had been in bed nearly seven weeks and we wished to increase his strength and heal the wound before removing the tumor. The wound closed in a short time and the boy's physical condition improved rapidly, but we waited for the inflammatory condition of the soft parts, which still extended well to the right submaxillary region, to subside, for the bony element of the tumor to harden, and for the tumor itself to become more defined before operating. With the disappearance of the soreness the tumor became more readily palpable and distinct, and the boy could raise his head more easily.

December 10, we considered the tumor to be "ripe," and operation was performed. An incision was made directly over the process, the

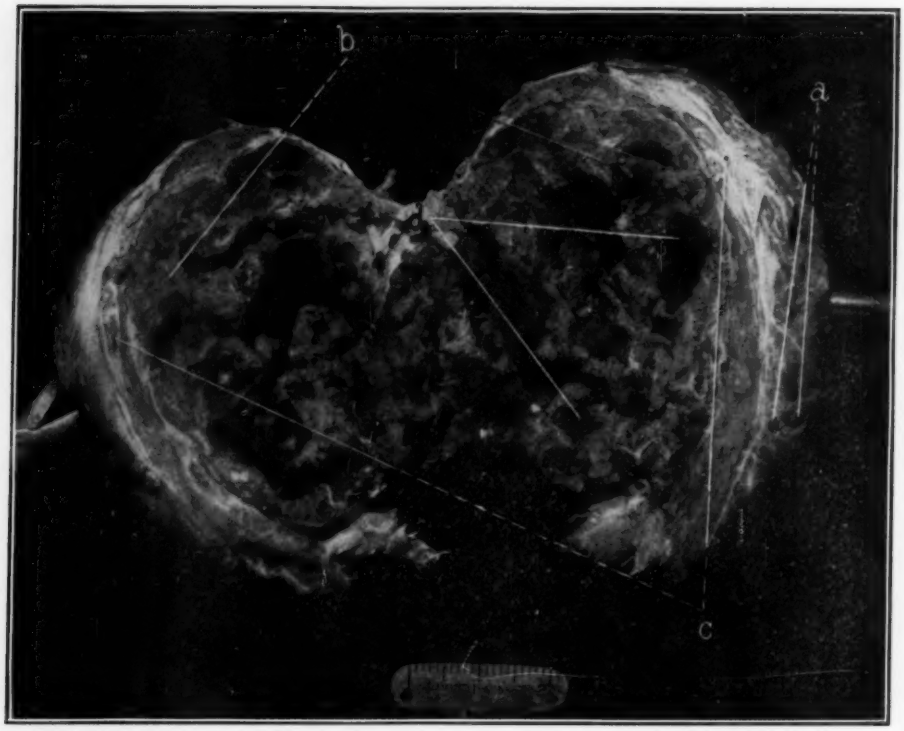


FIG. 2.—Section of the osteoma shown in Figure 1. a, muscle bundles; b, bone; c, capsule of tumor; and d, areas of hemorrhage.

muscles were separated, the gloved finger was introduced, and a circular tumor about 5 cm. in diameter was outlined. It was attached to the spinous and lateral processes of the third cervical vertebra on the right side. The muscles were stripped from around it by dissection with curved scissors. The wound was closed without drainage. Dr. A. C. Broders examined the tumor, microscopically, and reported that the specimen was a globular osteoma about 6 cm. in diameter, and was fairly encapsulated. On opening the tumor (Fig. 2) a fairly dense fibrous capsule was encountered, with trabeculae running into the surrounding muscle tissue. The interior of the tumor was made up of bone and fibrous tissue, the bone constituting a trabeculated framework. Scattered through the trabeculated areas were blood clots. Microscopic sections (Fig. 3) showed merely bone and fibrous tissue, with a few areas of leukocytic infiltration. No cartilage cells were to be seen. Some osteoblasts could be made out. Figure 4 shows the cervical spine after the operation.

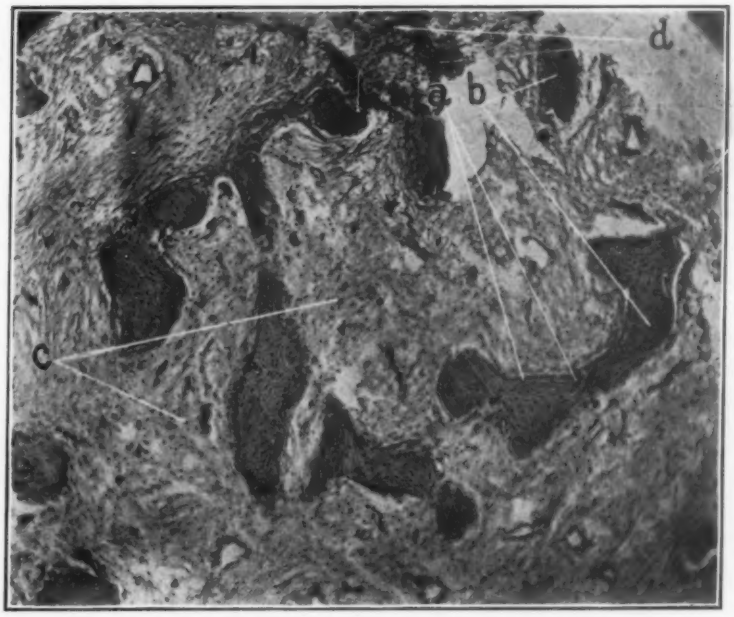


FIG. 3.—Photomicrograph of tumor (x 50): a, osteoblasts; b, bone; c, fibrous tissue, and d, leukocytic infiltration.

FIG. 4.—Cervical spine after removal of osteoma.

The patient's convalescence was uneventful and he was discharged December 20. A letter received, February 11, says that he had greatly improved although his neck was still stiff. He was taking exercises to correct this. Removal of the tonsils has been advised.

COMMENT.

The site of the tumor and the mode of onset are unusual. Bland-Sutton, in his book on tumors, mentions an osteoma that grew from the posterior surface of the odontoid process of the axis and caused death by pressing on the spinal cord. The case herein reported is the only osteoma of the cervical spine that has been recorded in the Mayo Clinic. The tumor was first manifested by severe pain, fever, and general malaise. Early exploration elsewhere was negative, but a secondary exploration two weeks later proved the presence of a tumor, and the pathologic report at that time was fibrous tissue and bone. Although our clinical diagnosis had been osteochondroma, on examining the tumor we could find only blood clots, fibrous tissue, and bone. The diagnosis was, therefore, changed to osteoma. Bone may form with or without cartilage as an intermediary stage, and in this specimen we could find no cartilage. The etiologic factor in the disease was clearly an infectious process, but bacteriologic studies were not made, because infection, or at least drainage of pus, had followed the second operation, and any observations on the type of bacteria would have been worthless. Whatever the type of bacteria, it in some way caused proliferation and growth of bone. We were unable to determine whether the tumor had its origin from the spinous process of the third cervical vertebra or whether it started in the deep structures of the neck and later became attached to the spinous and lateral processes of the vertebra. It is my opinion that it started in the muscle and fascia, and as it grew larger became attached to the bony normal structures beneath.

THE TREATMENT OF CONGENITAL DISLOCATION OF THE HIP AS PRACTISED BY PROFESSOR DENUCÉ AT BORDEAUX, FRANCE.*

BY Z. B. ADAMS, BOSTON, MASS.

Two years ago, at Toronto, I read a paper before this Association, in which I showed that the end-results of our treatment of congenital dislocation of the hip at the Massachusetts General Hospital Clinic were functionally, as well as anatomically, far from what could be desired and far from perfect. You all know the subsequent circumstances:—Dr. Galloway's paper, advocating open operation on all congenital dislocations, and last year the work of the Commission on Congenital Dislocation of the Hip, in which the end-results of the treatment at the larger clinics in Cleveland, Rochester (Minnesota), Rochester (New York), the New York Orthopædic Hospital, Johns Hopkins Hospital, the Boston Children's Hospital, and the Massachusetts General Hospital were studied. It then became apparent that our end-results were neither functionally nor anatomically perfect.

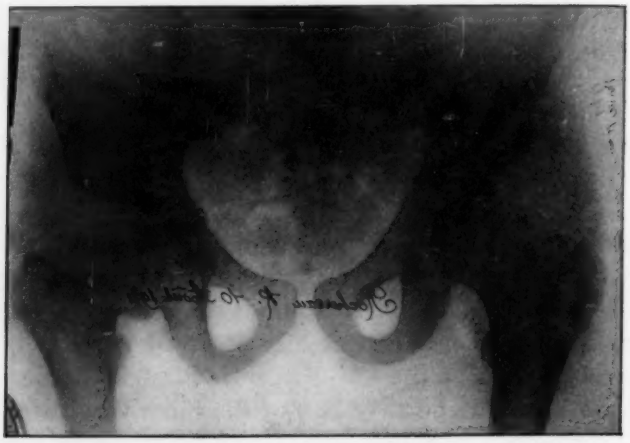
In view of these facts, I was interested by a thesis written by a young man named Dr. Edouard Papin, of Bordeaux, describing the treatment of congenital dislocation of the hip, as practiced by Professor Maurice Denucé, of Bordeaux, France. Having read this thesis, I was interested enough to go last summer to Bordeaux, in order to report to this Association my impressions of this treatment of Professor Denucé and of his end-results—anatomically and functionally.

Professor Denucé—whose name you have seen on the cover of the *Revue d'Orthopédie*, as one of its editors—is a surgeon seventy-odd years old; a rather frail man, but a student of surgery for many years. He is the Professor of Surgery of Children at the University of Bordeaux, and he is the author of many articles and theses—one being a thorough study of spina bifida. At the outbreak of the war, when he was sixty-five years old, he found himself called upon to take care of all the surgical cases at the Children's Hospital in Bordeaux—an institution one hundred and fifty years old. Since that time, he has reduced over nine hundred luxations or sub-luxations of the hip, with but few failures. The staff managing these cases consists of Professor

*Presented at the meeting of the American Orthopedic Association, May, 1922.

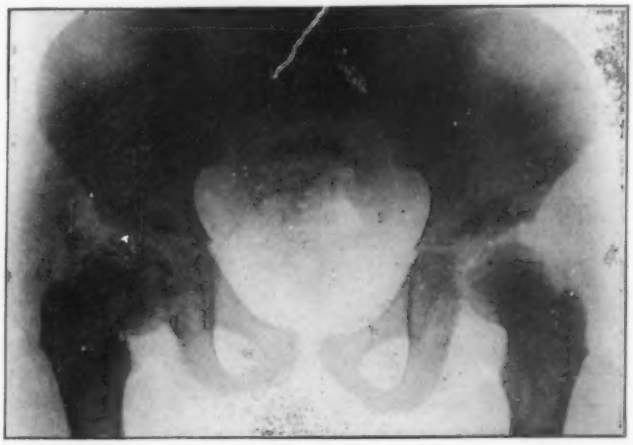
Denucé and two house students—assisted by an old French Sister of Charity nurse, some sixty-odd years old. The reductions are all done manually by Professor Denucé's very ingenious method. It is not very unlike the method of Dr. John Ridlon, but it is not the same, as the reduction is preceded by a manual stretching of the adductor muscles, and of this Dr. Ridlon does not approve.

PAUL GOMBERT.—Double; reduced at four years, April 25, 1918. August 10, 1921, perfect function.

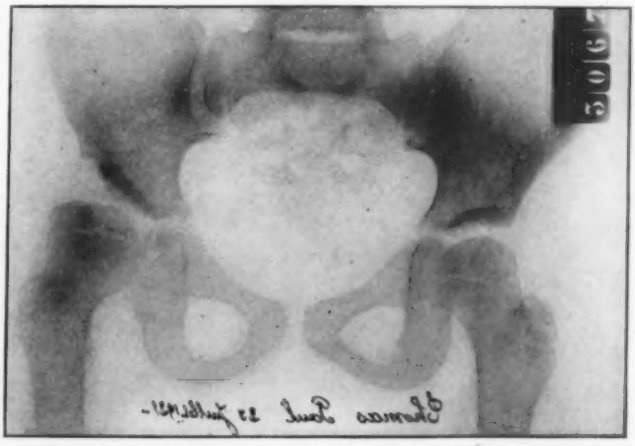


REINÉ ROCHEREAU.—Single; reduced at six and one-half years, August 14, 1917. August 10, 1921, perfect function.

This stretching is done by gentle stroking of the adductors with the soft part of the palm of the operator's hand—beginning at the pelvis, and stroking downward in the longitudinal axis of the thigh, the skin having been covered with powder. I may say here that, in Professor Denucé's reduction and treatment, he lays great stress upon the point that no violence or force is to be used. As the adductors are stretched,

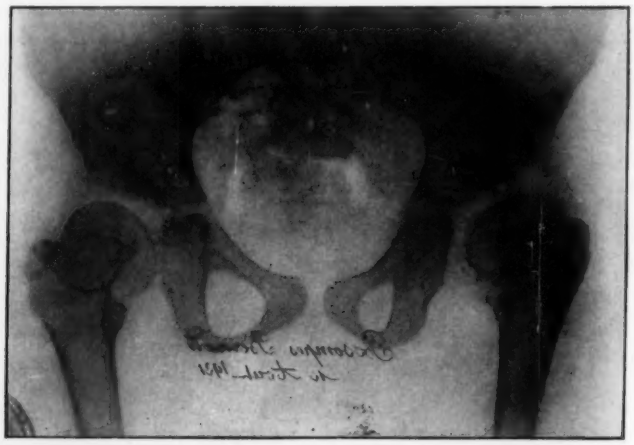


SUZANNE DIVIES.—Double; reduced at 15 months, April 16, 1916. August 10, 1921, perfect function.

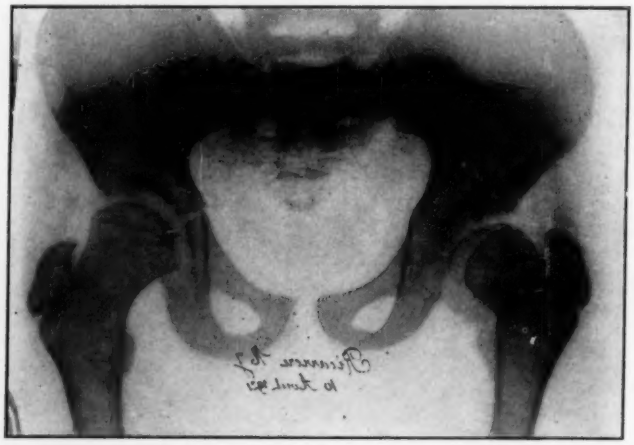


PAUL THOMAS.—Single; reduced at three years, March 14, 1918. July 28, 1921, perfect function.

the thigh is brought up to right-angle flexion and full abduction. Having stretched the adductors so that the thigh will lie upon the table at right angles with the trunk—the patient in the decubitus position—the attempt at reduction is then made. This is done by the operator standing on the side of the patient on which is the dislocated hip to be reduced; the thigh is flexed on the trunk,—the knee being carried across



BERNARD POSSOMPES.—Double; reduced at five and one-half years, May 16, 1918. August 10, 1921, little limitation of abduction at 90 per cent. of flexion; flattening of the left buttock; otherwise good.



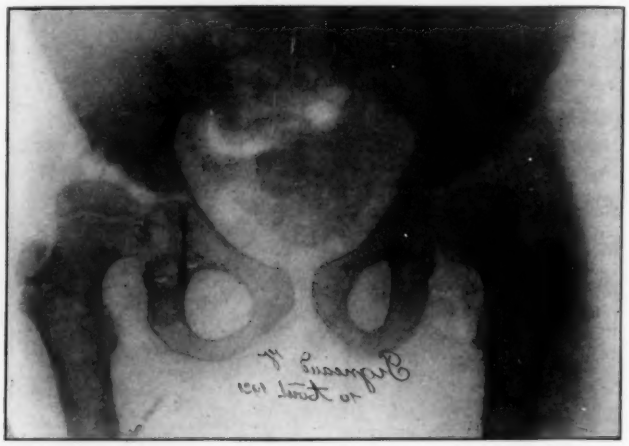
MARIE JEANNE RICARRÈRE.—Single; reduced at 6 years, May 17, 1917. August 10, 1921, perfect function.

in the direction of the axilla of the opposite side, and the thigh firmly pressed down on the anterior body wall. The knee is held in this position, a slight push being made in the longitudinal axis of the thigh. The fingers of the operator's other hand are placed under and around the head, neck, and trochanter, lifting up, and pressing the muscles in between the head and side of the pelvis; then circumduction is begun.

DENISE LEBBÉ.—Reduced at one year in 1914. August 10, 1921, perfect function.

ARLETTE LACOMBE.—Double; reduced at three years, March 14, 1918. August 10, 1921, perfect function.

The knee is carried across the body trunk to its own side, and then downward to the surface of the table, and then abducted,—all of this time the fingers behind the head are held firmly in place and lifting; the circumduction is slowly continued until the thigh is brought to a right angle with the body trunk and lying on the surface of the table—the assistant holding down the opposite side of the pelvis by a hand

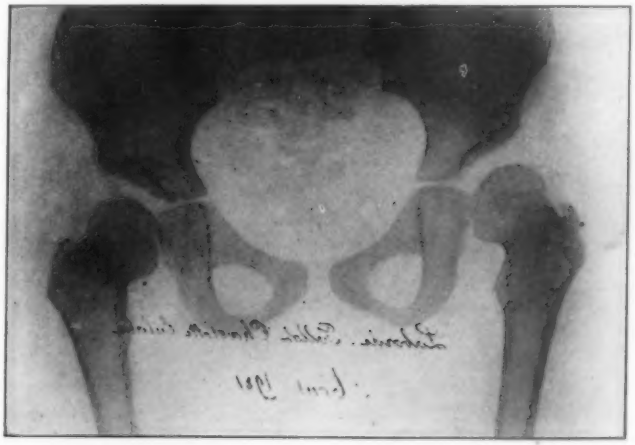


VALENTINE PIGNEAU.—Double; reduced at 18 months, January 9, 1917. August 10, 1921, perfect function.

MARCELLE CRESCOS.—Double; reduced at two years, October, 1917. August 10, 1921, perfect function.

over the crest and anterior spine. The head is felt to *slowly* come forward and lodge in the acetabulum. As some of the doctors have suggested, it "oozes" in. At times, the shock is very slight.

After the reduction, the hip is tested for stability,—the leg being drawn straight down; the point where the head jumps out is noted, and again the knee is brought up by being adducted at ninety degrees flex-



CHARLOTTE LABORDE-FALLOT.—Double; reduced at two years, June 12, 1919. August 10, 1921, perfect function.

LUCIENNE RODIER.—Double; reduced at two years, February 24, 1917. July 28, 1921, perfect function.

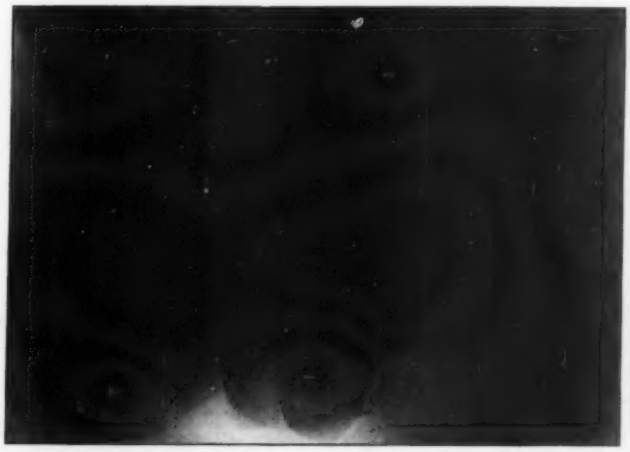
ion, and the point at which the hip jumps out of the socket is noted. Should the hip be very unstable, the plaster is applied with the thigh in a modified Wernsdorff position,—that is, ninety degrees of abduction and one hundred and ten degrees of flexion; but the ordinary case, with fair stability, is put up in what Professor Denucé calls "ninety-ninety," that is, ninety degrees of flexion and ninety degrees of ab-

GEORGETTE BOUNIORD.—Single; reduced at four years, July 15, 1920. August 10, 1921, not finished; still in salt baths; roof of socket forming; stable and good when reduced.

CLAUDETTE PORTENS.—Single; reduced at two years, March 27, 1919. August 10, 1921, perfect function.

duction. Over a single layer of bandage made of eiderdown cloth, and applied with the nap in, one layer of plaster bandage is put, and then a sheet of plaster of Paris, made from six thicknesses of crinoline, is moulded around the child, and this is fitted down and held in place by another layer of plaster bandage. The plaster extends from the nipple line to just above the ankle.

GERMAINE PENOUIL.—Double; reduced at two and one-half years, July 27, 1920. August 10, 1921, after 7 months of post-operative treatment.

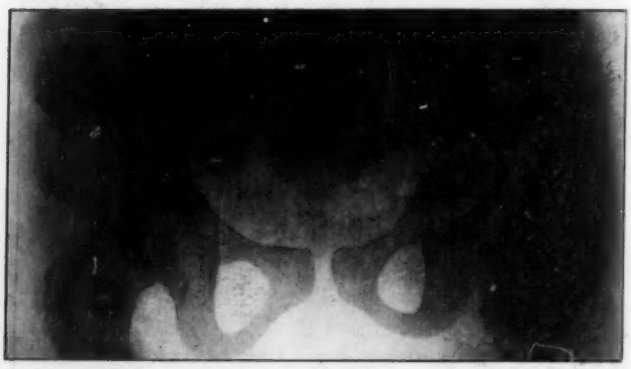


ROBERT FRITZ.—Double; reduced at three and one-half years, in 1918. August 10, 1921, perfect function.

Should he fail in his first attempt to reduce the hip, he does not repeat his trial, but puts the child up in traction for three weeks—drawing the head down, and then in a second attempt to reduce, he repeats the steps as before described.

The hip being reduced and put in plaster, Professor Denucé sends the child home, often immediately after the operation, allowing simply

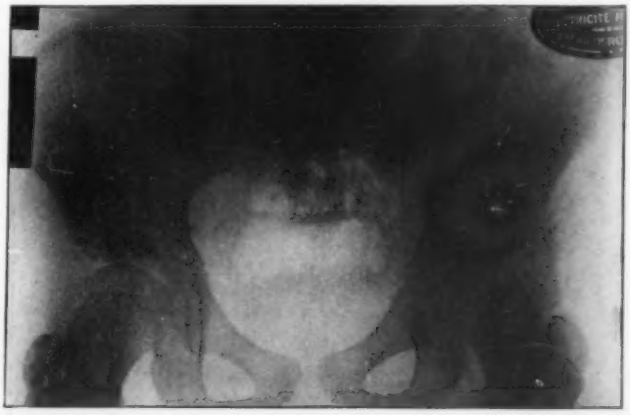
LUCETTE PRUNGNAUD.—Single; reduced at six and one-half years, June 20, 1916. August 10, 1921, little laxity, little clicking, no limp.



VICTORIA SUZINI.—Single; reduced at six and one-half years, June 27, 1918. August 10, 1921, little limp on left; 1 cm. atrophy on left; little increase in outward rotation on left; hyperextension little lax on left.

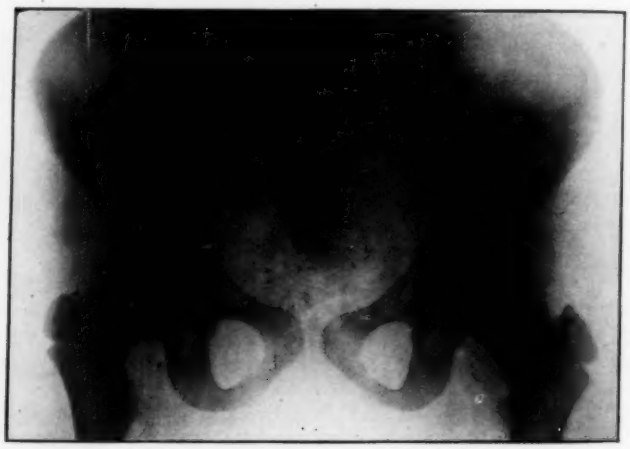
time for the plaster to set. There is no trauma, no ecchymosis, no danger, and no pain afterwards—providing the child is young. He sees the case again at the end of three months. The old Sister gives the parents directions about the care of the child in the plaster,—not to allow it to get the cast wet with urine, and to keep the child not in bed, but on the top of a flat, firmly padded table.

ELIANE BOUCHET.—Single; reduced at three and one-half years, April 6, 1916. August, 1921, 1 cm. of atrophy of thigh; perfect function.



YVONNE DUPEYRON.—Reduced at 4 years, May 9, 1919. August, 1921, perfect function; slight atrophy of glutaeus.

At the end of three months, if the child has grown rapidly, and on palpation the head of the femur is felt being pushed forward into the groin, the plaster is cut off above the knee, and the lower end of the femur and leg allowed to go free. The plaster is left intact, excepting for this change, and if the child has not grown too fast, the plaster is simply patched if soft, and allowed to remain in its entirety. At the

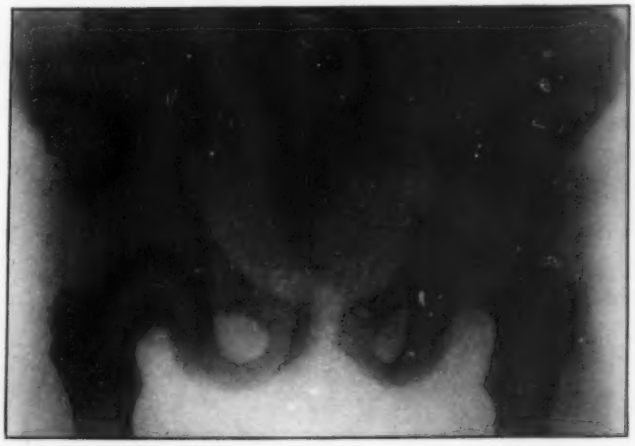


MARTHE FOURTAGE.—Reduced at two and one-half years, September 19, 1916. August 10, 1921, perfect function; slight laxity.

NOÉMIE SAINT-JOURS.—Double; reduced at 18 mos., August 31, 1915. Relapsed on left after 2 years; replaced; arthritis on left in 1918; treated by rest and plaster spica. August 10, 1921, perfect function.

end of six months—and Professor Denucé does not vary the time with variations in age—the plaster is bivalved into an anterior and a posterior valve, the child being bandaged into the posterior plaster, and the anterior plaster being thrown away. The parents are instructed by the old Sister in Professor Denucé's method of after-care.

YVONNE ROQUIE.—Double; reduced at four years, October 3, 1918. August 10, 1921, perfect function.



MARIE MERILLEAU.—Single; reduced at 18 months. August 22, 1918. August 10, 1921, perfect function.

Each day the child has an hour of hot sand, in a cloth bag, applied at the knee and over the front of the hip while lying in the plaster. After this heating, the child is coached to move its legs, to lift the femur forward, to straighten the knee, and to rock the lower leg. General heliotherapy is also given, beginning with periods of five minutes, and increasing the period daily five minutes until the child has one and one-half hours of sunning each day. At the end of two or three weeks, the posterior plaster is removed, and the child lies on the top of the firmly padded table.

The exercises are given twice a day, for a period of one-half hour each. No passive motion to the hip, but active motion; motion in abduction as well as adduction, and motion in rotation, flexion, and extension. The child is turned on its face, and taught to contract the gluteal muscles on both sides, and to rotate the thigh inward and outward while lying on its face, and to lift the thigh and hips off the table, and to swing the hips from side to side when lying prone on the table.

When the exercises have continued for three or four weeks, the child is given baths in a strong salt solution. This bath consists of a deep tank filled with salt and water, in the proportion of one and one-half kilos of salt to ten litres of water. The water is neck-deep in the tank, and there is space enough for the child to kick its legs. The child is carefully lifted from the table—the hip being gently supported—and is put into this tank. The water being more buoyant than the water in the Great Salt Lake, the child bobs up and down, the feet never touching the bottom of the tank. The child is left in this bath for from ten to thirty minutes, beginning with ten and increasing to thirty. The water is 70° Fahrenheit, or thereabouts. The baths are given daily for thirty baths, and then every other day for thirty more baths, and then there is an interval of a month, and then the course of three times a week is repeated for thirty more baths. The child is taken from the bath, and is wrapped in a warm blanket. The heliotherapy and exercises are continued, and the local heat with the sand-bag, and all through the child is made to keep the ability to abduct. In the cases of double hip, the patient sits for thirty minutes with the legs straight out, rotating in this position, while sitting straight up on the table,—the "split" act of the ballet dancer.

No weight-bearing is permitted on these hips until the center of ossification of the upper epiphysis of the femur is seen to have begun to increase in size markedly, and the head to shape itself, which is usually

three to five months after the removal of the plaster. Then walking is begun, with very short intervals of standing, and gradually increasing the time the child is allowed on its feet. The exercises, local heat, and baths are continued for many months; cases of thirty-one months of exercise are recorded. The function is almost perfect in all of the cases.

Several x-rays of the end-results of these cases are shown in this article. Unless otherwise stated, the method of reduction used is Professor Denucé's.

TENDON TRANSPLANTATION FOR MUSCULOSPIRAL (RADIAL) NERVE INJURY.

BY R. WALLACE BILLINGTON, M.D., NASHVILLE, TENN.

Associate Professor Orthopaedic Surgery, Vanderbilt Medical School.

ONE of the real surgical improvements resulting from the experience of the Great War was the more practical application of tendon transference to peripheral nerve injuries of the upper extremity, more particularly to musculospiral paralysis. It is now generally taught that such operations are to be performed only in cases with extensive nerve destruction which do not permit of end-to-end suture of the nerve or where suture has been done without return of function after a period of eighteen months or longer, or where for other reasons there is little or no hope of being able to restore power to the paralyzed muscles.

Some have advised using free nerve or other grafts to bridge extensive gaps and waiting for nerve recovery, but such procedures have usually been unsuccessful, even though slight return of power in some of the muscles may occur. I saw one case with partial recovery two years after such a nerve graft had been done, but it was so slight as to be of no practical value. On the other hand, I heard Sir Harold Stiles, of Edinburgh, say that he believed that tendon transference should be done without further delay in cases where the nerve could not be sutured under the most perfect conditions for recovery, as in extensive destruction and scarring of the soft parts, where end-to-end suture can be done only with considerable tension or where paralysis of long duration has resulted in extreme muscle atrophy. He contended that even if the nerve regenerated and power in the muscles returned later on that no harm resulted from the tendon operation.

The operation considered here is applicable, of course, only when the muscles supplied by the median and ulnar nerves are functionating normally. It is also essential that stiff joints and contractures of wrist and fingers be relieved before operation and that the soft tissues be free from scars and edema and otherwise in a state of good nutrition. Where the wound is near the elbow care should be taken to determine whether the muscular branches to supinator longus and extensors of wrist are

involved, as these are given off some distance above the joint. If the wrist extensors are acting it is necessary only to take care of the paralyzed thumb and finger extensors. Or, if only the supinator longus is intact, this muscle may be used to supply finger or thumb or wrist extension. I have not used this muscle for this purpose, though I have employed it in median paralysis with good result.

Sir Robert Jones and Major McMurray, of Liverpool, were the first to perfect and popularize a really successful operation of this kind. I had the pleasure of seeing some of their earlier cases while on duty at the Alder Hey hospital in the summer of 1917. Their technic and after-results soon convinced us that they had accomplished something which was a great boon to certain otherwise hopeless cases. In fact it seemed more successful than most of the tendon operations which we had all previously done for paralysis in the leg and foot in old poliomyelitis cases. This impression was later borne out in my own experience and in that of many of the others there at that time. The explanation of this is that in the lower extremity there is the all-important factor of weight-bearing and the necessary stability to be attained. We have often expected too much in this respect from transplanted muscles in limbs with more or less loss of power to begin with and with additional loss as a result of the transference, though the remaining power be ever so well balanced by the operation. Moreover, muscle reëducation seems to be more easily accomplished in the upper than in the lower extremity.

It is true that in the hand we have what may appear a more difficult problem, namely, the fine movements of the thumb and fingers. This difficulty I have found to be more apparent than real so far as musculospiral paralysis is concerned. When we analyze the situation, it is found that the important functions which are lost in these cases are, in order of their importance, extension of the wrist, abduction and extension of the thumb with its metacarpal, and extension of the proximal phalanges of the fingers. While the supinators longus and brevis are paralyzed, supination of the forearm and hand is accomplished quite well by the biceps unaided. It will be remembered that all the small muscles of the hand are supplied by the ulnar and median nerves. Another important fact often overlooked is that extension of the second and third phalanges of the fingers is performed individually and collectively by the lumbricales and interossei independently of the action of the extensor communis digitorum. This fact allows us to transfer a single tendon, the flexor carpi ulnaris, into all the long finger extensors without

seriously interfering with individual action of these four fingers. It is surprising what good individual function results in these fingers when all the long extensor tendons are tied to one transplanted tendon.

This is an important difference in the technic which I have used in the last seven or eight cases from that of Jones and McMurray whom I followed in my first cases. They attach the flexor carpi ulnaris to the long extensors of the middle, ring and little fingers only, and implant the flexor carpi radialis into the extensor indicis, extensor brevis pollicis and extensor ossis metacarpi pollicis, which, I am convinced, gives less perfect thumb function than when the flexor carpi radialis is attached to the three thumb extensors only, as in the operation to be described. McMurray justifies his omission of the extensor longus pollicis by the fact that the distal phalanx of the thumb can be extended by the action of the adductor transversus pollicis which sends a slip to the long extensor tendon. But this action on the distal phalanx is produced only when the thumb and its metacarpal are in adduction and palmar rotation. When they are in full abduction and extension it requires the action of the extensor longus pollicis to maintain extension of the distal phalanx. This fact can be easily demonstrated on the patient. Moreover, the extensor longus tendon has an important function in assisting in abduction and dorsal rotation of the thumb, an additional reason for joining it to the transplanted flexor carpi radialis. It is of the greatest importance to obtain full ability to abduct the first metacarpal and extend both phalanges of thumb and at the same time be able to perform dorsal or palmar rotation. And these movements should be independent of the index finger and not minimized by having the additional work and mechanical obstruction resulting from attaching the index tendon also to the flexor carpi radialis. The importance of these points is in getting a wide grasp. In fact, the wider the grasp between thumb and fingers the better the result, and much of this depends on the treatment of the thumb extensors.

Stiles, Danforth, and Baldwin put the palmaris longus into the three thumb extensors and the flexor carpi radialis into the extensor indicis. I had the pleasure of seeing some of the cases of these gentlemen at the Edinburgh War Hospital, and their results were quite satisfactory. However, their method is somewhat more complicated, involving more trauma, and showed no better results than from the one I shall describe. Moreover, the palmaris longus is absent in many patients and in others is too weak to be of use.

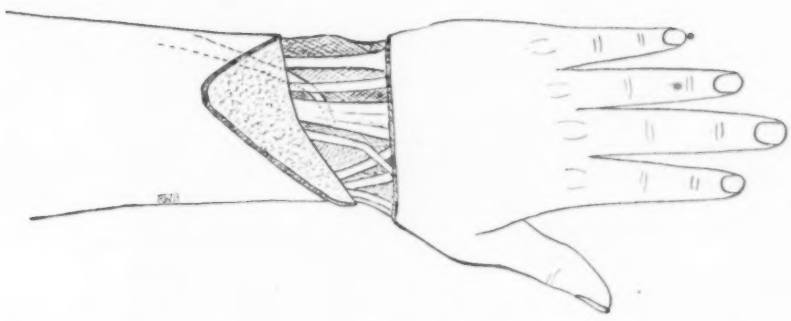


FIG. 1.—Showing exposure of tendons at the back of the wrist and the position of the flexor carpi ulnaris tendon after insertion into the finger extensors.

I wish to acknowledge my indebtedness to the authors of the first really successful operation of this kind. I hesitate to express opinions based on such a comparatively small number of cases, but the results have been so uniformly gratifying by the modified method which I have used that I take this opportunity of describing it in detail.

Two assistants are necessary, the whole duty of one of these being to carefully and continuously hold the wrist and fingers extended and the thumb abducted and extended during and after suture of the tendons until the special cock-up splint with thumb-piece is applied.

Three incisions are made: (1) one and one-half inches long over the radial border of the forearm at its middle, opposite the insertion of the pronator radii teres; (2) three-fourths of an inch long over tendon of flexor carpi radialis three to four inches above wrist; (3) starting on ulnar border of forearm, four inches above pisiform bone, passes straight down to the level of this bone, and turning at a right angle passes across dorsum of wrist to a point slightly beyond tendon of extensor ossis metacarpi pollicis just proximal to base of first metacarpal. This triangular skin flap is dissected up far enough to expose the finger extensors just proximal to the annular ligament, and the thumb extensors at the "snuff box" area over the carpus, avoiding injury to the radial nerve. These incisions give ample exposure with a minimum of dissection and trauma, as compared with the long U-shaped flap of the Jones-McMurray incision. In one case done by the latter method I saw a slight necrosis of the margin of the flap, which seems to me a real danger that can be easily avoided.

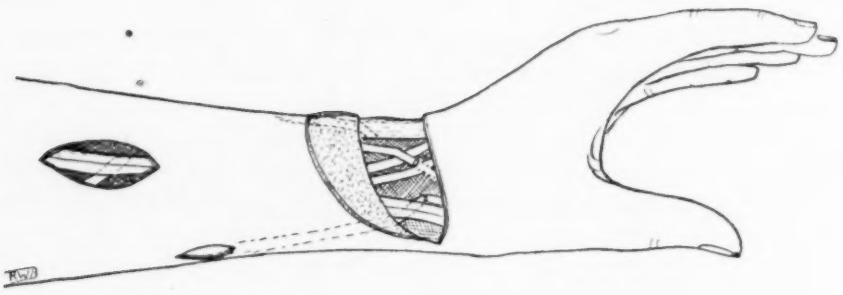


FIG. 2.—View of all three incisions from the radial aspect. Note arrangement of transplanted pronator radii teres and flexor carpi radialis, as described in text. Correct attitude of wrist, hand, fingers and thumb.

The short tendon of the pronator radii teres is now severed from its attachment to the outer surface of radius, having retracted the supinator longus forward. Buttonhole openings are made in the tendons of extensor carpi radialis longior and brevior as low down as possible to permit the severed tendon to be drawn through and sutured to each, after opposing surfaces of tendons are scarified to insure union. Fine silk is used and the exposed, ragged end of the tendon is clipped off flush with the receiving tendon and its raw surface buried with a suture. During and after suture the tendons should be under slight, equal tension with the wrist held in full hyperextension. Here, as elsewhere, the tendons should be handled carefully, avoiding traumatized or raw surfaces of tendons which might cause adhesions. It is important that both long and short extensors be used here so as to give better leverage for extending the wrist with less tendency to radial deviation of the hand than if only one were used.

Next the flexor carpi ulnaris tendon is exposed by sliding the skin slightly and is cut at its insertion, taking care to avoid the ulnar nerve and artery. The tendon is then freed upward as follows: Since muscular fibres are usually attached to within one-half to one inch of its distal end, these fibres are sheared off smoothly from the tendon up to a point two and a half inches above the wrist, leaving a perfectly clean tendon up to this point, and from there separating the muscle by blunt dissection in the line of its fibres obliquely to their attachment to the posterior border of the ulna about an inch higher up. The skin has not been dissected up this far on the dorsum of the forearm, so a tunnel is made subcutaneously from the highest point of the ulnar incision to the ex-

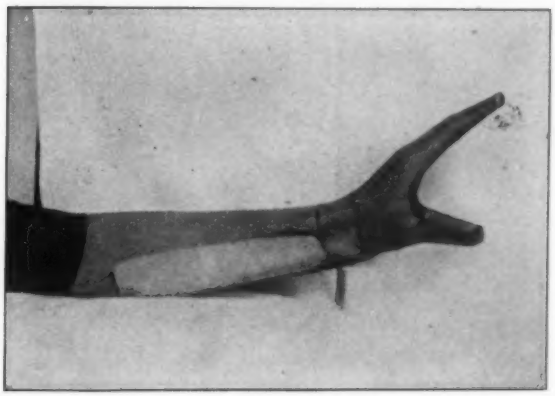


FIG. 3.—Hand on special long cock-up splint with thumb-piece, showing proper attitude of parts.

tensor tendons at the back of the wrist. The tendon and an inch or so of the muscle above are swung around to the back of the ulna and the tendon drawn through the tunnel, thus avoiding kinking or twisting and making the direction of muscle and tendon nearly a straight line from origin to new point of insertion. This procedure is simple if understood and insures good function of the transplanted muscle. The extensor minimi digiti and extensor communis digitorum tendons are exposed, by carefully incising and preserving the thin overlying fascia, then buttonholed obliquely from within outward and the transferred tendon drawn through and sutured to these four tendons in a similar manner to that previously described. It is not necessary to include the extensor indicis tendon. During and after suture all the tendons should be under slight and equal tension while the wrist and all four fingers are held fully extended. If the tension on the tendons is not equal it will be impossible to actively extend all the fingers fully. The fascia is then closed over the sutured tendons with fine catgut so as to prevent adhesions to the skin.

The tendon of the flexor carpi radialis is now exposed, by retracting the radial end of skin incision No. 3, and divided at its insertion. It is then hooked up through skin incision No. 2 and pulled out, then threaded through a subcutaneous tunnel to the styloid process of the radius. Incise and retract the fascia and expose the three extensor tendons of

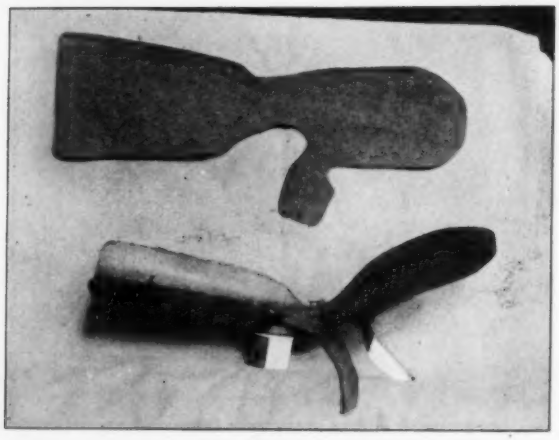


FIG. 4.—Pattern of special long cock-up splint with thumb-piece (above). Below is shown the finished splint. This is made of light, galvanized sheet metal, reinforced at the narrow wrist portion. A webbing strap with buckle at the ulnar border is riveted to the splint at its bend one inch distal to position of wrist joint.

the thumb opposite the carpus. Buttonhole the extensor ossis metacarpi pollicis and extensor brevis pollicis and draw the transferred tendon through. Sever the extensor longus pollicis tendon, slide the distal segment over alongside the extensor brevis pollicis and suture it end to end to the flexor carpi radialis. The two perforated tendons are fixed to the transferred tendon in the usual manner, after scarifying at proper points to insure union. Here again particular care is necessary to join the tendons under proper tension. It should be just enough to maintain the thumb and its metacarpal in full extension and abduction midway between palmar and dorsal rotation, and with the wrist extended. This position is carefully held until the splint is applied, which maintains it. The overlying fascia is closed with fine plain gut. All skin incisions are closed and iodined, light alcohol gauze dressings applied and the special long cock-up splint with thumb piece is applied, holding the wrist hyperextended, the fingers not quite fully extended and the thumb in position just described.

About a fortnight after operation the surgeon himself should remove the splint, carefully maintaining the same position, while the patient is first instructed and then told to make light voluntary contraction of the transplanted muscles. Proper resistance should be made by the

surgeon to prevent any flexion of the wrist, fingers or thumb during this effort, as it might loosen or stretch the sutured tendons. After each transplanted tendon is felt to tighten under the examining finger the splint is reapplied. This is repeated daily, gradually increasing the number and strength of the contractions. If at first it is impossible to get the patient to make the proper voluntary contraction the transferred muscles may be stimulated by a very mild faradic current.

Patients always take a keen interest in this muscle education. By the end of the fourth week the case can be safely turned over to a competent physical therapy assistant and the patient is told to make frequent voluntary contractions of the muscles while wearing the splint so as to improve muscle strength. The splint should be worn, except during supervised exercises once or twice daily, until about the tenth week, when it may be left off for increasing periods each day, regulated according to the strength shown in the given case. It has been surprising and gratifying to see how quickly these patients are able to reëducate the muscle impulses so that, for example, they do not have to stop and think about pronating the forearm and hand when extension of the wrist is wanted, etc.

At first it seemed questionable whether the pronator radii teres would be able to strongly extend the wrist after this operation. I still think this doubtful were it not for the assistance in this movement gotten through the action of the flexor carpi ulnaris on the finger extensors. This latter action is considerable and helps to replace the action of the paralyzed extensor carpi ulnaris, also thus helping to prevent radial deviation of the hand. At any rate, there is no doubt that satisfactory wrist extension is obtained by this technic, though it is evident that considerable power and resistance is required here when the opposing flexors are brought into action for grasping firmly.

No effort has been made to transfer tendon sheaths with the tendons, as has been strongly advised by some in all such work. In fact, the pronator radii teres and flexor carpi ulnaris have no sheath and there has been no serious trouble with adhesions in my experience.

Too much emphasis cannot be placed on the importance of obtaining free, active movements of the thumb, which are more complex than those of any other part of the hand and are very essential to good function. With the above operation properly executed one can obtain full active extension of both phalanges and the metacarpal combined with abduction or adduction and palmar or dorsal rotation,—in fact, practically complete function. This allows flexion of fingers while the

thumb is kept in the extended position, thus preventing the annoyance of having the thumb caught under the fingers when making a fist or grasping the handle of a hammer or golf stick or similar objects which are not simply to be caught between the tips of the fingers and thumb. With full finger extension this gives the widest possible grasp.

Success in this operation depends on many factors, the more important of which may be summed up as follows:

1. A thorough knowledge of anatomy and the individual and associated actions of all the muscles of the extremity.

2. Neat workmanship, perfect hemostasis, and a minimum of trauma of other tissues as well as tendons.

3. Suture of the different tendons under proper tension and in good alignment and covering sutured points with fascia.

4. Most thorough aseptic technic, as infection would damage if not altogether spoil the result.

5. Healthy tissues in the field of operation, free passive movements of all joints, and strong, active muscles supplied by median and ulnar nerves.

6. Use of a correct, specially made, long cock-up splint with thumb-piece (metal or moulded plaster) which will positively maintain the proper attitude of hand, fingers, and thumb during healing and after-treatment.

7. Thorough reëducation of muscles and physical therapy measures over a period of at least two or three months, remembering that the after-treatment is no less important than the operation itself.

As to results, naturally some cases have been better than others, even with the same operative technic. Experience is helpful. But in all of my own as well as in the patients of other operators mentioned as observed there was great improvement in function. I have seen no complete failures and none rendered worse in any respect by the operation. In fact, with an intelligent patient and a favorable condition of the tissues, one can be reasonably sure of getting a functional result closely approaching that of a normal hand.

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THE POST-OPERATIVE CARE OF FLEXION CONTRACTION OF THE HIP.

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LOVETT[1], in a recent communication to the American Orthopedic Association, showed that during the third year of the treatment of infantile paralysis about one-third of the cases showed loss of muscle power. This loss was due chiefly to increasing deformity. Furthermore, the single deformity causing the largest percentage of loss in any segment was hip flexion contraction, which accounted for 80 per cent. of the loss in the upper leg where the loss could be traced to deformity. Hence, a safe and efficient means of treatment of this deformity is highly desirable.

Soutter[2] described an entirely satisfactory operation for this condition not only in infantile paralysis but wherever it exists. He advised the immediate placing of the patient in the hyperextended position in a plaster jacket-spica. This procedure has been followed at the Children's Hospital for a number of years. Certain unfortunate experiences occurred with this procedure, not only at the Children's Hospital but in the hands of others. Death has been reported in a very few cases; severe circulatory disturbance has occurred in at least two others, and shock so severe as to endanger life has occurred in a number of others.

The exact explanation of these phenomena is not known. In the cases with circulatory involvement there was a sudden complete blockage of circulation up to a very definite level in the lower leg. Relief was secured only by reducing the degree of extension. In one of these cases a secondary shut-down occurred demanding still further flexion. In each case the blockage came on several hours after the hip had been extended. It was felt that this was probably due to a vasoconstrictor influence on an already flattened vessel—the flattening having occurred as the result of stretching and extension.

In the cases of shock and death there was no apparent circulatory involvement of the leg and we are inclined to think that it may be due

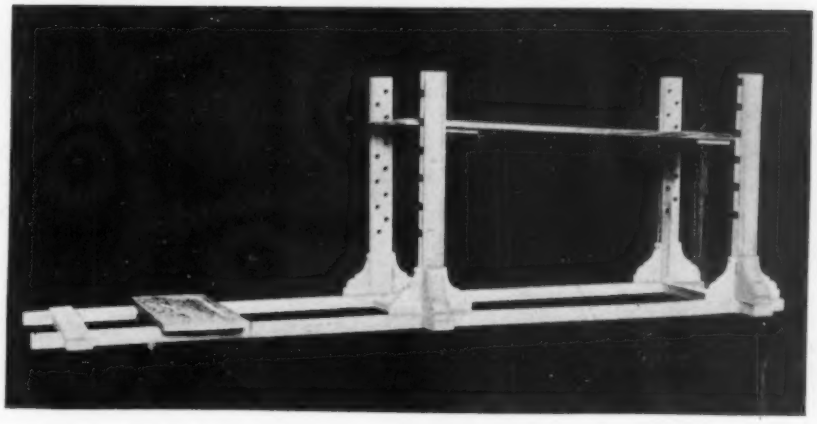

FIG. 1.

to the pain of stretching the contracted nerves or to the sudden painful lordosis of the lumbar spine resulting, possibly, from a slight contracture of the ilio-psoas muscle, but in no case at the Children's Hospital has it been necessary to loosen the ilio-psoas from its attachments.

These considerations led to the construction of a bed, which consists of a rather narrow frame which rests on the cross-bars of the bed. On this frame for a base there are erected four uprights—two at the head, and two at the middle. The uprights are notched to receive cross-bars of iron, and the distance from notch to notch is one inch. On the iron bars a cleated board is placed which is to act as a bed board for the patient's body. A narrow footboard is fitted with cleats so that it can be moved forward and backward on the foot of the frame. (See Fig. 1.)

With this apparatus one is able: (1) to get adequate fixation of the pelvis and body, by either a plaster jacket or a pelvic band and perineal and shoulder straps; (2) to permit gradual hyperextension by raising the bed board one or more notches a day; (3) to correct any adduction or abduction elements of the deformity by changing the position of the feet on the foot board from day to day; (4) to adjust the frame to any patient by means of the adjustable foot board. (See Fig. 2.) Such a frame can be constructed by any carpenter at a minimum cost.

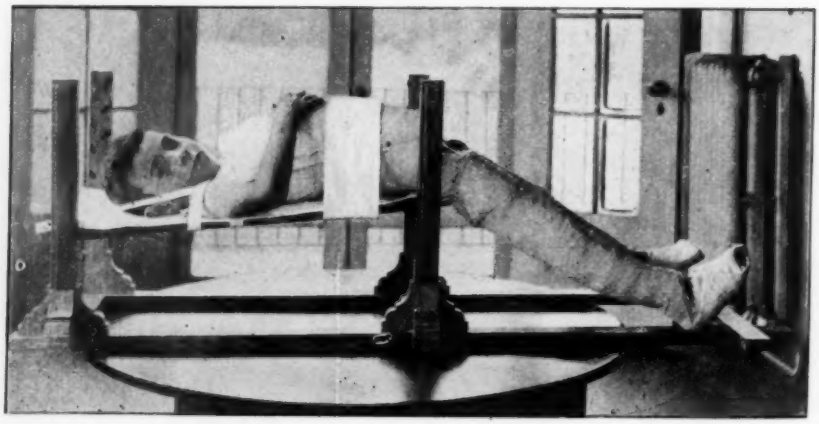

FIG. 2.

The after-care of these patients at the Children's Hospital now is as follows: the patient is put up in a gauze dressing at the close of the operation and permitted to lie with the knees flexed for ten days to two weeks. The wounds are then dressed and the leg and foot put up in plaster. The method of application of the jacket is of no small importance. The patient is placed either on a spica board or a hammock with his legs flexed until his back is flat. The jacket is applied and carefully moulded around the spines, trochanters and the pubis and sacrum. The child is now laid on the frame without a pillow under his shoulders, and the bed board is put in the lowest notch and the legs are put on a level with the body, or with the slightest hyperextension. The child is kept from slipping off the board with perineal straps, and is prevented from sitting up by means of shoulder straps. From day to day the height of the bed board is raised, the amount of raise being governed by the development of pain. The foot board is adjusted to the heels each time the board is raised. When the desired height is reached the child may be permitted to lie on the apparatus until the completion of treatment, or the legs and jacket may be joined together in the hyperextended position and the child transferred to an elevated Bradford frame. After six or eight weeks in full hyperextension the plaster is removed and one proceeds with the correction of any other deformities.

A person who has once suffered from a hip flexion contraction is likely to have a recurrence unless carefully watched. The recurrence

is usually due to a desire on the part of the patients to sit most of the time, or because the brace is too short and they try to sit on top of it. These patients should lie for several hours a day on the abdomen with the legs straight down from the pelvis, or else they should lie on the back with the pelvis supported on a couple of pillows. It is very important to keep the braces of the proper length.

Since the introduction of this method of handling these cases over a year and a half ago there have been no untoward results, pain and discomfort have been much less, and the bed care has not been made any more difficult.

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THE PAINFUL TRAUMATIC SHOULDER.

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PAIN in the shoulder region is an exceedingly common condition. It may come on insidiously without any very obvious cause or it may appear immediately after an injury. Of gradual onset are cases of tuberculous infection, of new growth, and of osteoarthritis. With these I do not propose to deal. I wish to consider more particularly cases where the onset is somewhat acute, and more especially those which follow an injury. My attention has been focused upon this matter from encountering, within a very short interval, a number of cases presenting symptoms and signs which, while varying in extent, were similar in the two points of localized tenderness and localized atrophy. So far as I am aware, the influence of minor injuries to the brachial plexus in shoulder-joint injuries has never been emphasized. The cases which form the background of this communication are explicable on the basis of such a lesion, and no other.

These cases form a logical series leading up to the fully established brachial palsy. Following textbook teaching, we are too apt to concentrate upon high lights only. Thus in examining shoulders we feel satisfied if the deltoid is apparently uninjured, and in brachial palsies we are accustomed to think of "upper arm types" of "lower arm types," and of these combining to form the complete palsy. We do not appreciate how comprehensive a term "brachial palsy" is. It includes all lesions from the slight atrophy of the infra-spinatus at one limit to the slight wasting of thenar and hypothenar eminences in cases of cervical rib, at the other limit. The transition is gradual, not abrupt, and such terms as "Erb's palsy" or "Klumpke's paralysis" should be discarded.

The violence causing the interference with function may be directly applied to the shoulder itself, or indirectly, or combined. The violence may be sufficiently great to cause a fracture in the neighborhood of the joint. In such cases the fracture—if a gross one—absorbs the surgeon's attention and accompanying conditions are subsidiary to it. Many cases, however, show no obvious fracture, and yet for months there may be pain on movement of the joint, and limitation in the range of movement. The cause of this pain and limitation is often obscure and not

infrequently the patient's curiosity is satisfied and the surgeon's omniscience safeguarded by the comforting phrases "sprain," or "rheumatism." A search for a focus of infection may be instituted, a carious tooth or a septic tonsil dealt with, and in course of time the condition improves, finally clearing up. So far all is satisfactory, unless the disability refuses to clear up.

The aim of the surgeon must always be to visualize the pathological anatomy of a lesion if his treatment is to be rational and his prognosis trustworthy, and one has the feeling that a good many chapters in the pathology of the shoulder-joint are still unwritten. Not at all uncommon is the condition of painful shoulder-joint following a fall on the outstretched hand, as described by Jones. (Injuries to Joints, 1915.) A Colles fracture may or may not be sustained. Some weeks later, pain and stiffness are felt in the corresponding shoulder-joint. The original violence has been transmitted directly to the humero-scapular articulation, bruising the cartilaginous surfaces. Cartilage being an avascular structure, time is required for the ingrowth of vessels to repair the damaged tissue, and after this has been done still further time is required for the obliteration of the reparative vessels, leaving the joint almost as good as before the accident, or else, which is much less likely, with impaired function due to intraarticular adhesions, according to the degree of violence and the damage sustained.

Violence which is frankly indirect may in a similar manner produce a traumatic bursitis affecting the subacromial bursa. Here we are dealing with tissue more readily vascularized; the onset is more rapid, and the reaction more acute than when the cartilaginous surfaces alone are involved. At other times the brunt of the fall is borne, not by the shoulder-joint itself, but by the clavicular flying buttress. The clavicle most frequently gives way. On the other hand, the medial extremity of the buttress may show the effect of the violence in an acute traumatic arthritis of the sterno-clavicular joint. The acromio-clavicular joint is not usually involved in lesions due to a fall on the outstretched hand, since the line of transmission of the strain is through the head of the humerus to the glenoid part of the scapula, and from there to the clavicle, *via* the conoid and trapezoid ligaments.

Most of our patients, however, who come with painful shoulders after injury describe the condition as resulting from "a fall on the shoulder," incurred in such activities as a railway accident, a fall from a horse, or tumbling down the basement steps in the dark. It is not always possible to get an exact description of the circumstances at the

moment of impact, but the broad fact emerges that it is a "head-first precipitation."

Sometimes there is actual evidence of violence applied to the skull. Frequently there is no abrasion.

Examination of the shoulder region immediately after the accident reveals considerable limitation of movement. Active movement is generally very limited indeed, while passive movement is apt to be painful. At this stage one must be guarded in regard to diagnosis. The general bruising usually clears up in two to three weeks and an estimate can then be formed of the full degree of damage done. It is at this stage that mistakes are likely to be made. The improvement has been fairly rapid in regard to relief of pain, and one is tempted to give a prognosis of continued amelioration. This is not always justified. Many of these shoulders will continue to be painful and disabled for many months, some of them permanently. Very careful investigation will frequently reveal marked tenderness about the supra-spinatus and infra-spinatus, the deltoid may be tender also, as well as the teres minor and teres major where they form the bulk of the posterior axillary fold. Careful comparison with the other side will generally display distinct atrophy of some of these muscles.

In examining a shoulder one's attention is too apt to be concentrated upon the deltoid to the exclusion of the other muscles, which must be acting well in order to give perfect function at the shoulder-joint.

Of these muscles, the supra-spinatus, and still more the infra-spinatus, are most liable to be injured. Next in frequency are the deltoid and teres minor, and after that the teres major and clavicular portion of the pectoralis major are apt to show atrophy. In some cases time will compass an almost complete restoration of function, but the condition where permanent weakness and atrophy of the infra-spinatus remains is an exceedingly common one. This is apparently the muscle most easily affected, and the absence of its action from the shoulder-joint muscle team constitutes a real disability. This is most pronounced when work has to be carried out with the arm raised above the shoulder level—*e.g.*, a carpenter working upon a roof—but the effect of its absence is usually made out fairly readily.

If the patient be asked to raise both hands straight in front of him to shoulder level, there is usually a difference in height, the affected side being slightly lower. Further, if the hand be stretched straight out from the shoulder in the coronal plane, the hand on the affected side is slightly lower and the affected shoulder is heaved up more

than the other. Another test that may be made demonstrating weakness of external rotation is to seat the patient squarely in front of a table, and ask him to sweep the hands outward while the elbows rest upon the table, the forearm forming the radius of a circle of which the elbow is the center. The lagging behind in the case of the affected side is usually well marked.

While the affected muscles are recovering they are usually distinctly tender to pressure, and this tenderness is likely to persist for many months.

What is the mechanism involved in these painful shoulders? Occasionally, perhaps, it is the partial rupture of fibers of a tendon which, while held taut, is suddenly subjected to an unusual strain. Such a case is the following:

F. A. C., aged 43, was struggling to wrest a knife from an intoxicated man. About half an hour later he began to have pain in the right shoulder region. When examined about three days later he showed no sign of bony deformity and no bruising, but slight fullness in the right infra-clavicular fossa, slight pain about the deltoid insertion, and marked tenderness over the lesser tuberosity of the right humerus. Active and passive movements at the right shoulder-joint were carried out fairly well except in the one direction of outward rotation, which was almost nil.

In this case there was, in all probability, some rupture of fibers of the subscapularis.

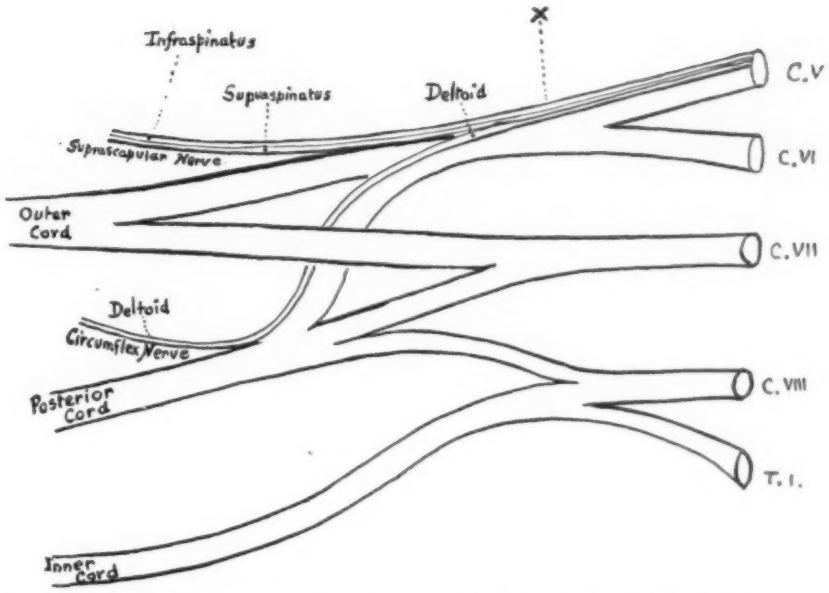
Most frequently, however, the widespread involvement of muscle, the long-continued tenderness, and the tardy recovery point to a different origin. When supra-spinatus and infra-spinatus alone are involved, one is tempted to attribute the condition to a lesion of the supra-scapular nerve alone. Where the nerve passes through the supra-scapular notch, the supra-scapular ligament is stretched tightly over it. The sudden stretching of the nerve might cause it to impinge on the ligament sharply, a movement equivalent to the nerve being struck smartly by the ligament, the sequel being a traumatic neuritis. In view, however, of the fact that the involvement is often more widespread, including deltoid and teres minor, one is tempted to seek a vulnerable point where fibers to these muscles are more closely associated. This one finds in the upper trunk of the brachial plexus. Forcible separation of the head from the shoulder places the upper trunk of the brachial plexus on the stretch, and this is apt to cause damage to any muscles supplied from the 5th and 6th cervical nerves. Now, of the muscles around the

shoulder the deltoid, supra-spinatus, infra-spinatus, teres minor, teres major and subscapularis, as well as clavicular fibers of the pectoralis major, are all supplied from the 5th and 6th cervical segments. Why the infra-spinatus should suffer most frequently and severely is doubtful, unless it be that the fibers going to this muscle are the uppermost fibers of the uppermost brachial trunk, which is extremely probable.

There is, therefore, in many shoulder injuries a minor degree of Erb's paralysis, exactly comparable to the birth palsies, due to exactly similar mechanism, and varying as widely in degree. The actual lesion, no doubt, varies from a hemorrhage into the sheath to actual rupture of nerve fibers. When the violence is severe there may be complete paralysis of the whole upper limb as in case M. S. All gradations from this are possible. The more gross lesions are not likely to be overlooked, but minor degrees of damage to the uppermost trunk are more frequently missed than observed. Patients are usually satisfied when the real state of affairs is explained to them, and a reasonable prognosis given. When surgeon and patient alike are waiting for something to turn up, neither is wholly satisfied with the other. Careful observation will frequently disclose a condition which affords a reasonable explanation of why the shoulder has not returned to normal, and if the slowness and uncertainty of recovery in nerve injuries be appreciated and explained, a more contented frame of mind is likely to prevail on both sides.

As regards treatment of these conditions, the general principles should be relative rest, active movement being permitted only to a degree which does not cause fatigue or pain. Passive movement is called for only in sufficient degree to prevent contracture. If the joint be moved once per day through its full range of movement this is sufficient. Massage and electricity may be useful adjuncts.

The illustrative cases are arranged to show: First, a brachial plexus lesion, involving the fibers of the 5th, 6th and 7th cervical. Next, a less severe lesion, involving only the 5th and 6th cervical. The third case is that of an old injury, where permanent damage has occurred to the fibres forming the supra-scapular nerve. The fourth case, seen shortly after the accident, has paralysis of the deltoid, the supra-spinatus, and infra-spinatus. Soon after he came under observation the deltoid recovered apparently completely, but the other two muscles were still out of action. The fifth case is one where the supra-spinatus and infra-spinatus fibers are still inactive, and this case shows a scar on the head which gives a key to the mode of occurrence of the lesion.



Brachial Plexus to show Path of Fibres to Infraspinatus, Supraspinatus, Deltoid.
X—Region where injury occurs in lesions described.

The sixth case, and seventh, are practically transient supra-scapular lesions.

ILLUSTRATIVE HISTORIES.

1. M. S., age 27. Laborer.

On the 18th of November, 1918, a wheelbarrow fell from a hoist, striking him on the left side of the head and the left shoulder. There was immediate complete loss of power of the left arm. When seen by me for the first time, on February 17, 1919, he showed much atrophy of the deltoid, spinati, posterior axillary fold; indeed, of all the muscles of the left upper limb, except the small muscles of the hand. Loss of sensation (pin prick) over radial border of forearm as low as the wrist. This was a severe lesion of the upper part of the brachial plexus, due to forcible separation of head and shoulder. Under treatment with massage, electricity, and the use of an abduction splint, the condition has very gradually improved, so that some power is present in nearly all the muscles. Most of the tenderness has disappeared, but over the infra-spinous fossa and posterior axillary fold this is still present.

2. C. L., 48 yrs. Millwright.

On October 11, 1919, patient was standing upon a plank, one end of which was supported by a beam and the other end upon a crane. The

crane was moved from under the plank, and he was thrown to the ground.

When examined on November 16, 1919, he had good power in the muscles of the forearm; at the elbow-joint only moderate power of flexion and good power of extension. Atrophy of the deltoid, supra-spinatus, and infra-spinatus was pronounced. These muscles responded to galvanism, but not to faradism. On December 11, 1919, increase of flexion at the elbow was noted, and by January 5, 1920, voluntary power was present in the deltoid. Improvement continued steadily. A note of June 10, 1920, states, "Marked tenderness on firm pressure over the infra-spinatus. Most of the flexion at the elbow is carried out by the brachio-radialis." Atrophy of the spinati even after fifteen months is still pronounced.

3. W. R. J., age 65. Market gardener.

Six years ago, while shingling a roof, fell about nine feet, striking his right shoulder. For about three months he could not lift the arm at all at the shoulder. Now he finds difficulty in working above the level of the shoulders.

Examination of right shoulder showed some limitation of movement in all directions for active, but none for passive movement. There was no atrophy of the deltoid, but complete atrophy of the infra-spinatus and partial atrophy of the supra-spinatus. One of the patient's chief troubles was that he had not quite the same old punch in boxing as before his accident. No treatment was advised in this case.

4. H. M., age 32.

On September 28, 1920, this man was in a railway accident. He does not know the details as to how he landed. He was in hospital for twelve days with fractured ribs.

When examined on October 23, 1920, the supra-spinatus, infra-spinatus, and deltoid, on the left side, were not acting. Marked tenderness was present over the infra-spinous fossa and the posterior axillary fold.

On November 23, 1920, practically a full measure of recovery had been obtained in the deltoid, but the atrophy of the other muscles mentioned was still quite marked.

5. P. P., age 50. Laborer.

On October 30, 1920, patient was standing in the back of a wagon when it suddenly started forwards, precipitating him to the ground. He injured the right parietal region of the skull and the right shoulder.

The head wound healed up rapidly, but, in spite of assiduous painting with iodine, the shoulder was still disabled.

When examined by me on January 3, 1921, a healed scar was observed over the right parietal bone. Swelling was present over the sternal end of the clavicle; atrophy was marked in the infra-spinous fossa. The deltoid was acting normally. Marked tenderness was present in the supra- and infra-spinous fossae. The supra-spinatus and infra-spinatus muscles reacted to galvanism, but not to faradism. In this case the record of how the lesion occurred is exceptionally plain.

6. Mrs. C. E. M., age 65.

On October 10, 1920, fell downstairs into the basement, injuring the left shoulder.

When examined on January 1, 1921, marked tenderness was present over deltoid, supra-spinatus, and infra-spinatus. The deltoid showed voluntary power. Limitation of movement made it impossible to test the spinati for voluntary power. Very slight atrophy was present in the infra-spinous fossa.

7. N. B. H., age 24. Farmer.

Was in same railway accident as Case No. 4, on September 28, 1920. Was in hospital with diagnosis of dislocation of left shoulder. When examined by me on October 11, 1920, there was some weakness of the deltoid and some tenderness over the infra-spinous fossa. No atrophy. By January 7, 1921, the deltoid had regained practically full power. Tenderness had disappeared from the infra-spinous fossa. An x-ray taken on October 11, 1920, shows a detached piece of bone, probably in connection with insertion of supra-spinatus.

It is important to recognize minor degrees of injury to the brachial plexus, not merely with a view to maintaining cordial relations between surgeon and patient, but still more on grounds of equity. Of the cases cited, two are cases where a claim for damages was made against a railway company. In three out of the seven the Workmen's Compensation Board required a report before instituting compensation. In only two out of the seven was there no medico-legal interest. These cases are comparatively common, and exact diagnosis is likely to be demanded much more frequently than before the Workmen's Compensation Act came into force. Recognition of the fact that the deltoid is not the only muscle acting upon the shoulder-joint, and that minor, even transient, injuries of the brachial plexus are frequent, will lead to fairer estimates of disability.

CONGENITAL ANKYLOSIS OF JOINTS OF HANDS AND FEET.

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CONGENITAL deformities of the hands and feet present a very interesting type of anomaly in that they illustrate how striking abnormalities in osseous structure may give rise to but little disturbance in function. Prior to the use of the x-ray there were few cases of ankylosis of the hands and feet reported, and the accounts were lacking in many details. It was not until 1902 that an exhaustive treatise on this subject appeared in the form of a monograph, by Hans Engel[1]. He divides these cases into four groups, differing from one another by the extent of the involvement of the osseous system and the hereditary factor.

GROUP I. ANKYLOSIS OF THE JOINTS OF THE HAND, WHICH, THOUGH PRESENT AT BIRTH, IS NOT HEREDITARY.

Such cases are found in the literature only in connection with pectoral muscle defects, and may be well illustrated by the following reports:

Benario[2], 1890. Defect of the right pectoralis major muscle and 4.5 cm. shortening of the right hand. The fingers have but two phalanges. Fusion of the soft tissues between the fingers. Marked hypertrophy of the nail of three fingers. Not hereditary.

Berger[3]. Boy with defect of the right pectoralis major. Fusion and shortening of the first three fingers. The little finger has only two phalanges, a long proximal and a short distal phalanx. Not hereditary.

Fürst[4]. Man with a defect of the right pectoralis major. Right hand poorly developed and fingers fused. The M. flexor digitorum sublimis inserts at the bases of the terminal phalanges proximal to that of the profundus on the second and third fingers. Thumb normal. The index finger has no middle phalanx. On the second finger the proximal part of the terminal phalanx is much shortened. On the ring and little fingers the middle phalanx is very short. The metacarpals are normal except for a shortening of Nos. 1 and 2. The usefulness of the hand is in no way altered.

Hoffman[5]. Man with a defect of the right pectoral muscles and a shortening of the arm. On the index and middle fingers a short middle phalanx is fused with the end phalanx. On the ring finger the joints are all present but motion is limited. On the little finger the middle phalanx is absent, and the proximal phalanx very long. There is marked webbing of the fingers. The man's occupation is limited to a coarse type of work.

Klaussner[6]. Man with a defect of the left great pectoral muscle and shortening of the hand. The fingers are webbed. All the phalanges are shorter than normal. The middle and terminal phalanges are fused on the index and little fingers. The usefulness of the hand is not impaired.

Poland[7]. Defect of the pectoral muscle, absence of all of the middle phalanges, and marked webbing of the fingers.

Skodowski[8]. Defect of right pectoral muscle. Defect of the middle phalanx of index and second fingers. On ring finger bony ankylosis between all three phalanges. Webbing present. Heredity not mentioned.

Stintzing[9]. Man with defect of right pectoral muscles. Poor development of entire right arm. Ankylosis of all distal interphalangeal joints. Heredity not mentioned.

GROUP II. ANKYLOSIS OF CERTAIN FINGERS OF ONE HAND.

The corresponding fingers of the other hand are normal. The condition is hereditary.

Joachimsthal[10]. Father and daughter with abnormal shortening of the fingers and ankylosis of joints. On the first three fingers the very short midphalanx is united with the proximal phalanx. The site of the joint is marked by a thickening of the bone. On the little finger the middle and terminal phalanges are absent.

Pagenstecher[11]. Kyphotic girl with a small left hand. Heredity not known. The father is supposed to have a small hand. The metacarpals lack the normal tubercles, prominences, etc. The phalanges are small and short. On the middle finger the phalanges are fused into one bone. On the little finger the middle phalanx is absent.

Wolfe[12]. Ankylosis of the proximal and middle phalanges of one hand. The hereditary transmission of the defect may be understood from the following diagram:

GROUP III. HEREDITARY ANKYLOSIS OF THE FINGERS OF BOTH HANDS.

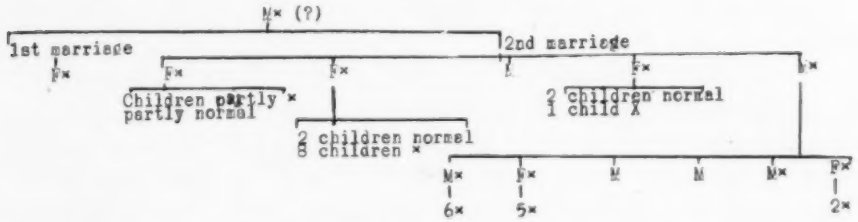
This group includes also the cases from the old literature in which only the defect in the middle phalanx is noted.

Colson[13]. A stunted development of the middle phalanges traced through three generations.

Joachimsthal[14]. Brother and sister with ankylosis of all of the interphalangeal joints. Defective nail formation and polydactylism.

Kellie[15]. A defective development of two phalanges of all fingers with exception of the thumb. The deformity had involved all the female members of the families through ten generations.

Kimmel[16]. Absence of the middle phalanx in many members of one family. Careful investigation of the family tree revealed the following deformities: Thumb — Broad, short, proximal and long distal phalanx. Index and middle fingers — Very long proximal and long end phalanx. Ring finger — Very short proximal, very long end phalanx. Little finger — Proximal and end phalanges same length. The usefulness of the hands is not appreciably diminished.



Walker[17]. Hereditary ankylosis of finger-joints of both hands through several generations.

The deformities were as follows: Ankylosis of the proximal joint of all fingers; absence of middle phalanx of ring and little fingers, except on left hand. All phalanges are present but fused into a solid bone. The sites of ankylosed joints are marked by a thickening of the bone. In all cases investigated the normal skin folds were absent over the ankylosed joints. The usefulness of the hands was not materially affected.

GROUP IV. HEREDITARY ANKYLOSIS OF THE HANDS AND FEET, INCLUDING THE BONES OF THE ANKLE AND WRIST.

This group may be illustrated by the following reported cases:

Kirmisson[18]. In one family the father and two out of six children affected by ankylosis of the hands and feet as follows:

Father: Congenital pes varus. Fusion of tarsal bones. In the hands, ankylosis of the proximal interphalangeal joints. Function of the hands very little disturbed.

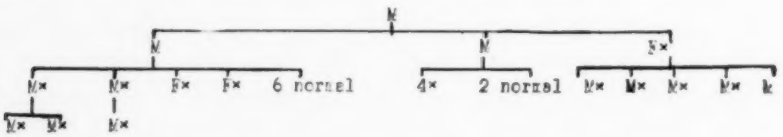
First Child: Boy with defects as the father, except that on the little finger the last two phalanges are fused.

Third Child: Girl with pes varus, ankylosis in tarso-metatarsal and interphalangeal joints, the tarsal region being one solid mass of bone. X-rays of hands and feet show the following defects: Hand—Fusion between proximal and middle phalanges of index and middle fingers on both hands; also on ring finger of right hand; also between middle and end phalanx of both little fingers. In the wrist the multangulum majus seems fused with the first metacarpal, the multangulum minus is separated from the capitalum and second metacarpal by a very indistinct boundary line. The triquetrum is either absent or fused with the hamatum. The pisiform is not recognized. The navicular lunatum and hamatum are clearly recognized. Foot—All middle phalanges absent. The two phalanges are fused on No. II and III toes. The first metatarsal is fused with the cuneiform. The second and fifth metatarsals show no proximal boundary line. The tarsal region is a solid mass of bone. The third metatarsal is poorly developed; the fourth very broad; fifth pushed laterally.

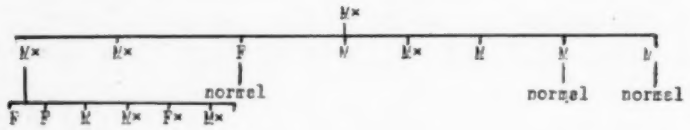
M'Kinder[19]. Defect of the middle and last phalanges of both hands and feet in many members of a family extending through six generations.

Ogle[20]. On the index and middle fingers are only two phalanges, on ring and little fingers only one. The affected fingers are without nails.

The same defects are present on the feet. The hereditary transmission is as follows:



Engel, H.[21]. Case A: Servant, male, 20 years. Left upper arm 1 cm. shorter than the right; left thigh 2 cm. shorter. All fingers and toes have only two phalanges, a long proximal and a shorter distal one. These defects do not hinder the usefulness of the hands or feet. The hereditary factor is as follows:



Hands:—In all joints of the hands motion is restricted. The normal skin folds are absent over the proximal interphalangeal joints where there is no motion. There is a thickening of the bone at the site of the ankylosis. Left index finger 8 mm. longer than the right.

X-ray:—Fusion of proximal and middle phalanges of first three fingers and of middle and end phalanges of the little fingers, the proximal phalanx being absent. Of the metacarpals the first seems widest. The other four have a thickening of the distal ends which is most pronounced on the index and diminishes toward the little finger. The first metacarpal is unusually broad, a condition which may be explained on the basis of it being a true phalanx and not a metacarpal. In the wrist one recognizes a naviculare, then a bony mass made up of lunatum and triquetrum; the pisiform is wider than normal. In the distal row is a multangulum minus and capitalum; finally a hamatum.

Feet:—Both feet are unusually broad and short. Motion in all joints restricted. Both great toes normal. Marked webbing of the other toes. Second toe has only two phalanges. The third toe of left foot is deformed and seems to be made up of only one bone; on the right foot it is unusually small, has a well-developed nail, and has two phalanges. On both feet the fourth toe is much shortened, has no nail, and is made up of only one bone. The little toes have but two phalanges.

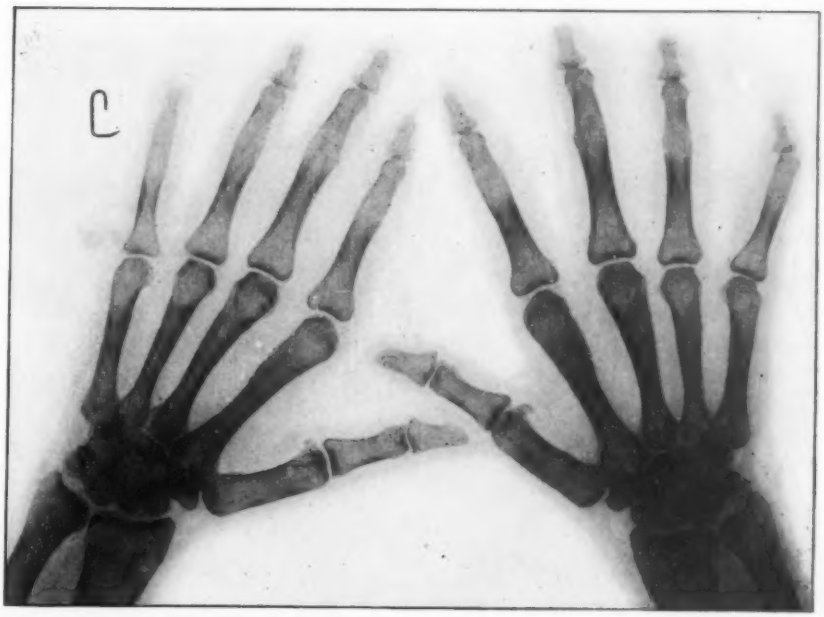


FIG. 1.—The proximal and middle phalanges of all of the fingers, and the middle and terminal phalanges of the left little finger are fused together by a bony ankylosis, the joint sites being marked by a thickening of the bone. The scaphoid is normal. The semilunar is fused with the unciform and cuneiform. The pisiform is normal. The trapezium is normal. The trapezoid and os magnum are fused together.

X-ray:—Middle phalanx absent from all toes. On left third, as well as both fourth toes, the end phalanx is also absent. Both sesamoids absent on the right great toe; on the left tibial, one only is present. The fifth metatarsal is displaced laterally and out of the line of the foot. In the ankle the cuneiforms I, II, and III are fused with the corresponding metatarsals, and on the right foot cuneiform III fused with the cuboid. The calcaneus, cuboid, and fourth metatarsal form one bony mass, which apparently is used chiefly in walking. The naviculare seems to be joined to the talus.

Engel, H. Case B: 18-year-old boy. Brother of Case A. Shortening of the left upper and lower extremities. Movement of joints of hands and feet limited.

Hands:—All fingers have no proximal joint, but a thickening can be felt. On ring and little fingers of right hand, the terminal joint also is lacking.

FIG. 2.—The proximal and middle phalanges of all toes except the great toes are fused together and form a wide proximal half of the distal phalanx. The metatarsals are normal.

X-ray:—On fourth finger of right hand, end and middle phalanges fused. At the site of fusion is a line which may represent the remains of an epiphyseal line or a joint space. At the site of fusion between proximal and middle phalanges of all of the fingers there is a thickening of the spongy marrow space. Epiphyseal lines of the proximal phalanges all show clearly. On the metacarpals all epiphyseal lines are present except No. I. One sesamoid bone is absent on the left hand.

Feet:—Both flat, unusually short and broad. On second toe midphalanx absent, the three last toes are very short and are apparently without joints; nail absent on third and fourth toes. Last four toes webbed.

X-ray:—Both sesamoids of great toes absent; second toes lack middle phalanx; other toes possess neither end nor middle phalanges;

FIG. 3.—In the tarsal region there are three bones instead of seven. Cuneiform I is normal. Cuneiform II and III are fused together. Cuboid, naviculare, astragalus and calcaneus are fused into a solid bony mass.

proximal phalanx very rudimentary. First metatarsal fused with cuneiform I; fourth fused with cuboid. Cuneiform II very small; cuneiform III fused with cuboid.

The case presented by the author is that of an Italian woman, aged 40 years, with congenital ankylosis of joints of both hands and feet, thus falling in Group IV, as classified by Engel. As far as she knows, none of her relatives have been similarly affected, and both of her children are normal.

Examination:—A well-developed, middle-aged woman, about 5 feet 4 inches tall, weighing 150 pounds. She walks with a noticeable shuffling gait. At first glance, the hands appear to be normal except for

an angulation at the distal joint of the right little finger, but upon closer inspection the skin folds over the dorsum of the fingers are not present and there is an ankylosis of the proximal joint of all of the fingers. Movement in all other joints is normal except for ankylosis of the distal joint of the left little finger. Motion at the wrist is free. The arms are equal in length and there is no defect in the muscular development about the chest or shoulders. The feet are extremely flat. All of the toes except the great toes have but one joint, the proximal one being ankylosed. The feet otherwise present no abnormalities aside from a reduced mobility of the ankles.

The x-ray reveals the following condition:

Hands (Fig. 1):—The fingers are of normal length and shape except for a lateral angulation of the distal joint of the right little finger. The proximal and middle phalanges of all the fingers, and the middle and terminal phalanges of the left little finger are fused together by a bony ankylosis, the joint sites being indicated only by a thickening of the bone over an area approximately 1.5 cm. long. This thickened area is made up largely of cancellous bone and the cortical bone is thinned out to a fine line.

In the carpal region five bones are present instead of eight. The scaphoid is normal. The semilunar is fused with unciform and cuneiform. The pisiform is normal. The trapezium is normal. The trapezoid and os magnum are fused.

Feet (Fig. 2 and Fig. 3):—The proximal and middle phalanges of all toes except the great toes are fused together and form a wide proximal half of the distal phalanx. The metatarsals are normal. In the tarsal region there are three bones instead of seven. Cuneiform I is normal. Cuneiforms II and III are fused together. Cuboid, naviculare, astragalus and calcaneus are fused into one solid bony mass.

COMMENT.

From the foregoing we may conclude, as did Engel, that congenital ankylosis of the bones of the hands and feet is usually hereditary, and when not hereditary it is, as a rule, associated with a developmental defect of the corresponding pectoral or shoulder group of muscles. The case here presented is out of the ordinary in that, as far as we know, the condition is not hereditary, and it is not associated with defects elsewhere in the body. The etiology of this condition is not known. Men are more commonly affected than women, and the hands

are more commonly affected than the feet. As a rule, the interphalangeal joints only are involved in ankylosis, but, as in our case, the carpal and tarsal regions may be affected as well. The fact that the thumbs are normal might lend weight to the view that the proximal bone of the thumb is a true metacarpal instead of a phalanx, yet developmentally the position of the epiphyses would confirm the opposite view.

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A SIMPLIFIED METHOD OF MEASURING AMPLITUDE OF MOTION IN JOINTS.

BY NEIL G. ROSÉN, M.D., NEW YORK.

THE great importance of accurate measurement of amplitude and strength of movements in disablement of the limbs is now well recognized and need hardly be emphasized by me. It is of vital importance in *treatment*. Here it gives the physician a record of the functional improvement taking place and of the effectiveness of the respective therapeutic measures instituted in each case. I know of many cases from my own experience in which there appeared to be no progress, but after accurate measurements had been recorded, it was found that a steady, albeit slow, increase in amplitude and strength of motion was taking place. The psychological effect of this on the patient is, of course, clear; it gives him a concrete evidence of the regeneration going on, which upholds his morale and greatly stimulates recovery.

Exact knowledge of the extent of disability present is also of paramount value in *medical reports*. Laws providing compensation for injuries sustained in industry are now becoming well-nigh universal, and the physician is often the sole arbiter as to the amount of disablement present. The justice of the awards depends on the accuracy of his records. Everyone who has had experience with the disablements resulting from the war, or with cases coming up for adjustment in the State Industrial Commissions, must admit the great difficulty that exists about indefinite reports. The following medical report was submitted in an accident case which came up for adjustment in one of the State Commissions, and I think it is illuminating. "There has been a fracture of the shaft of the humerus with possibly some overlapping of the fragments and considerable formation of callus. Motion in shoulder-joint is somewhat restricted; extension in elbow is slightly restricted. There is considerable decrease of motion in wrist-joint and loss of use of hand. The general tone and power of the muscles of the arm is diminished." Puzzle: Find the disability present. There are many similar reports in existence.

Another matter which is badly in need of attention is the great con-

fusion of terms used in recording measurements. In one report, for instance, it is stated that there is 45 degrees of flexion possible in the wrist; in another, the flexion in the same wrist is called 135 degrees. In the former the angle subtended by the hand and the forearm, when they are in a straight line, is considered as zero; in the latter it is called 180 degrees. Some writers compute range of supination from full pronation, others from mid-pronation. Sometimes the right angle in the ankle-joint is made the basic angle from which the motion in that joint is measured; at other times the complete angle formed by the foot and the leg is considered. Some physicians name anterior motion of the arm in the shoulder-joint, extension; others, flexion; sometimes the thumb is labeled the first finger; at other times the index is honored in this manner, and so on. It is very desirable that a uniform system should be adopted. It would do away with all this obscurity, and greatly facilitate the interpretation of the medical reports.

Actuated by the necessity arising through the war, when so many disabilities of the extremities had to be treated and recorded, a great number of instruments were devised to register the amplitude of movement at the various joints. Among these are "goniometers" for the knee-joint; specific instruments for measuring supination and pronation, and fleximeters for elbow, ankle, wrist and finger-joints. The "arthrodynamanometer" of Amar records the range of movement of the several joints, and also the power of the flexor and extensor muscles. The "dynamoergograph" of Camus records graphically the force, rapidity and amplitude of movement, and the fatigability of the injured limb. Amar's "Dynamographic Pear" registers the power of the partly paralyzed hand.[1] For description of these instruments I refer the reader to the literature on the subject. They are all more or less complicated, and while of great value in exact scientific work, the great majority of these apparatus are too elaborate for routine work. The larger joints may be measured comparatively easily with a simple fleximeter, but the difficulty has been to find a practical way of measuring and recording disability of the finger-joints. Dr. J. Appleton Nutter of Montreal, Canada, to whom I am indebted for many valuable suggestions which have been made use of in this paper, published an article in the *Journal of the American Medical Association* in 1919[2], in which he pointed out that, on account of the great number of joints involved, the tabulation of deformity and motion of the fingers in degrees has been found a most tedious undertaking. Such records, how-

ever accurate, are also very unintelligible. He described a very ingenious method of graphically recording the deformity of the finger-joints by means of diagrammatic drawings representing the hand and fingers. These drawings were made free hand, and in them a single line or succession of lines represented forearm, wrist, and each of the three phalanges. Free-hand drawings, useful though they are as a guide in treatment, bring in the personal factor, and will vary as the skill of the individual differs in estimating the several angles involved. They can hardly be accepted as scientific or legal records.

In the following, I have endeavored to present a simple system of measuring and recording range of motion in the extremities, which I believe is not readily open to misinterpretation, and is sufficiently exact for use in industrial accident work, and for the general practitioner.

Mensuration of Amplitude of Motion in Finger-Joints by the Aid of the Author's Phalango-fleximeter:

By aid of the phalango-fleximeter which is described below, the deformity and range of movements in the fingers is registered, and recorded graphically with exactness and rapidity, and the result can be read at a glance.

The apparatus (See Fig. 1 (a) and Fig. 1 (b)) consists of two main parts, a metal plate ab, and an irregularly shaped disc, D; the latter being joined with the former through aperture in elevated part of ab, by means of screw S, in such a manner that when the screw is loosened, D revolves through S. The plane of ab is at right angle to D. About one inch posterior to S is a notch K. D is made of thin celluloid, with a glazed surface for marking with a pencil, such marking being erasable. The plate ab is placed securely on the dorsum of the metacarpal bone, corresponding to the finger which is to be measured, so that K comes exactly opposite the metacarpo-phalangeal joint (the knuckle), and D is suspended between the finger to be measured and the adjoining finger; the center points of the dorsal surfaces of the proximal and distal interphalangeal joints, as well as the tip of the finger, are then marked off on the disc. In order to get a graphic record, a transparent sheet of paper is now placed on top of D, so that one border of the paper is parallel with ab and touches K. Point K, as well as the three points marked off on the disc, are copied on the paper and connected by straight lines (See Fig. 2). It can readily be seen that this gives an exact record of the deformity present in the finger; by making one record of flexion and another of extension, and placing one over the

other, you may read the range of motion at a glance. By loosening the screw S, D can be adjusted so as to fit hands of different size, and also to the thumb, which requires more space on account of its thenar eminence. The disc D, as well as the plate ab, are identically the same on both sides, so that one side can be used for the two medial and the other for the two lateral fingers on the hand.

Mensuration of Amplitude of Motion in the Large Joints:

Motion in the large joints, excepting the shoulder- and hip-joints, and the rotary movements, may be registered with fair accuracy, as has already been stated, by means of a simple fleximeter; a practical type is shown in Figure 3. The fleximeter is placed alongside the joint so that the pivot of the instrument comes right opposite the pivotal point of the joint, and the two arms of the fleximeter are parallel, respectively, with the upper and lower bones forming the articulation. The range of motion is then read off in degrees on the circular scale attached to the instrument; the scale should be marked to 360 degrees. The shoulder and hip-joints may conveniently be measured by means of a chart, such as is reproduced in Figure 4. This chart is placed on the wall and can be raised and lowered by means of a string and pulley, so as to bring the centrum of the chart opposite the shoulder- or hip-joint, respectively. When flexion and extension is registered, the subject is placed sideways, and when measuring abduction and adduction, with the back to the chart.

The principal rotatory movements which need registration in routine work are: inward and outward rotation in shoulder, supination and pronation of forearm, inward and outward rotation in hip, and inversion and eversion of foot. The amplitude of these movements cannot be measured by any simple instrument. By carrying out the following procedure, however, they may be computed with approximate accuracy.

Inward and Outward Rotation in Shoulder-joint:

Place upper arm parallel with body, with right angle in elbow-joint, and forearm in antero-posterior plane. Forearm can then be moved outward slightly more than 45 degrees, normally, and inward until restricted by body; by noting the excursion of the forearm, the amount of rotation present in the shoulder can be easily computed.

Supination and Pronation of Forearm:

Place arm in the same position as stated above, hand vertical with

thumb up; in this position forearm can normally be pronated 90 degrees and supinated 90 degrees; by using the thumb and hand as an indicator, any deviation from the normal can be estimated.[3]

Inward and Outward Rotation in Hip:

If subject is able to stand; place feet parallel in antero-posterior plane (one foot apart for inward rotation), and mark rotation on the floor; if bed-ridden, place patient on level couch and measure angle formed by foot and couch. Measure both sides for control.

Inversion and Eversion of Foot:

This motion cannot be measured with any accuracy in degrees. It is best expressed in percentage of normal, counting the normal as 100 per cent.

Tabulation of Measurements:

The following system has been adopted at the Clinic for Functional Reëducation in New York after a lengthy trial, and has been found accurate and easy to interpret. I wish to express my thanks to Dr. William V. Healey, who was mainly responsible for its introduction in the above institution, and whose method has been followed in this account.

In this system the angle formed, when extreme extension is present in a joint, is never made the basic angle for mensuration, nor are the various "neutral" positions considered. The angles presented in these positions are not constant. They vary in different individuals, and sometimes also in the corresponding joints of the same individual, due to structural dissimilarities, which may be either physiological or pathological. The only thing that concerns us is the size of the angles subtended at the two extremes of the excursion in the joint; the difference between these two gives us the range of motion which, when compared with the normal, expresses the disability that is present. For instance, on measuring the amplitude of movement in the wrist-joint shown diagrammatically in Figure 5, the active flexion is registered first; it is 135 degrees. The limit of active extension is then registered from *the same side;* it amounts to 225 degrees in this case. On subtracting the former from this figure you get the range of motion, which here is 90 degrees. When passive motion is to be registered, the procedure is the same, excepting, of course, that the mensurator has to perform the movement. A report for voluntary motion may be made out as follows:

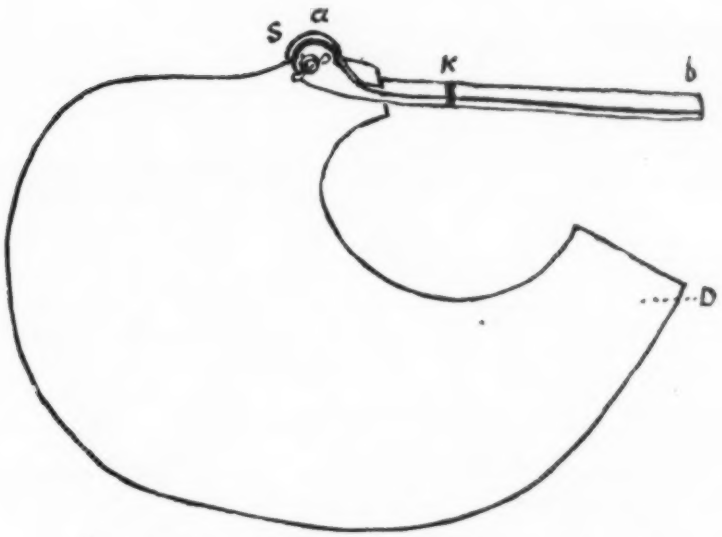

FIG. 1 (*a*).—Phalango-fleximeter (Rosén).

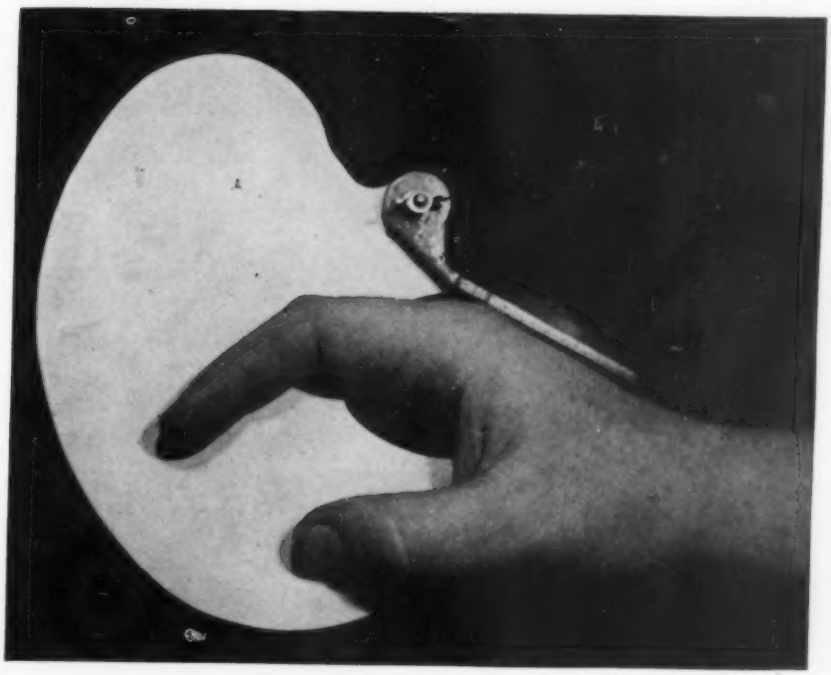

FIG. 1 (*b*).

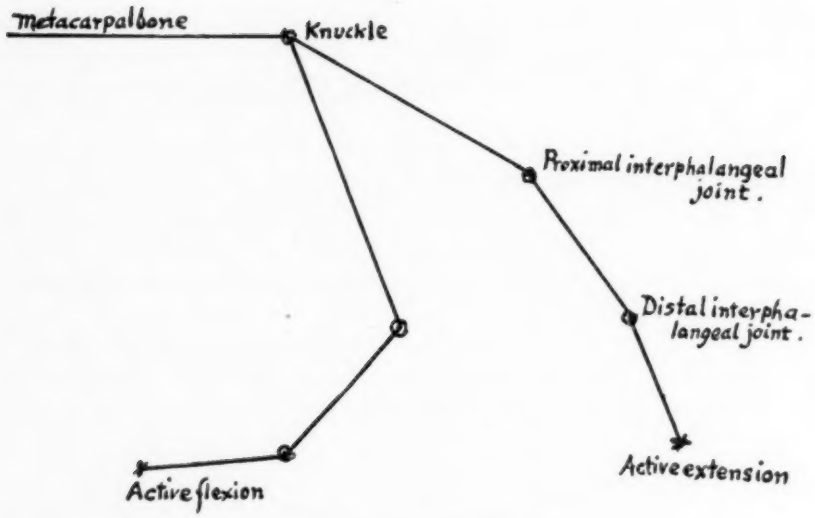

FIG. 2.—Graphic record completed.

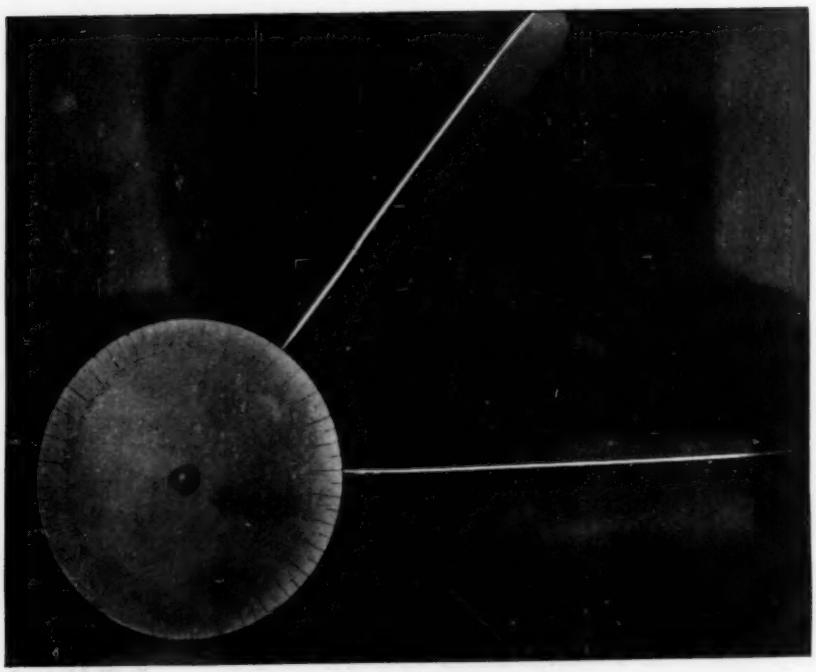

FIG. 3.

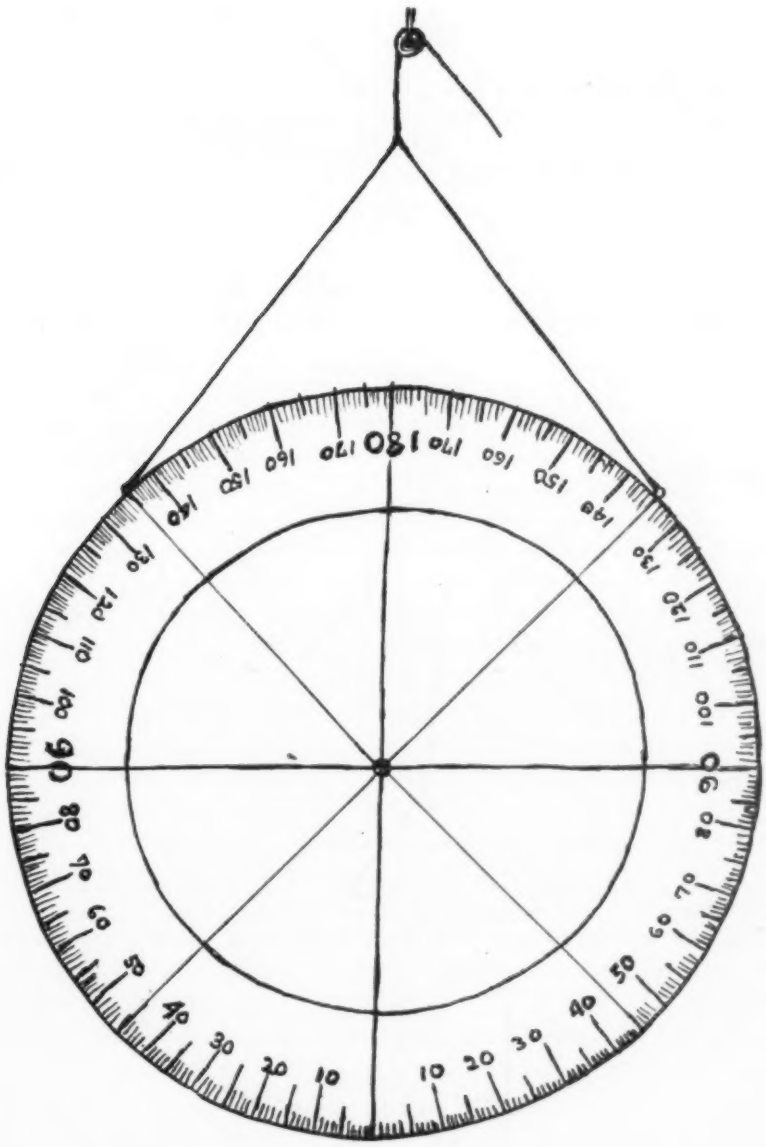

FIG. 4.—Chart for measuring motion in shoulder and hip.

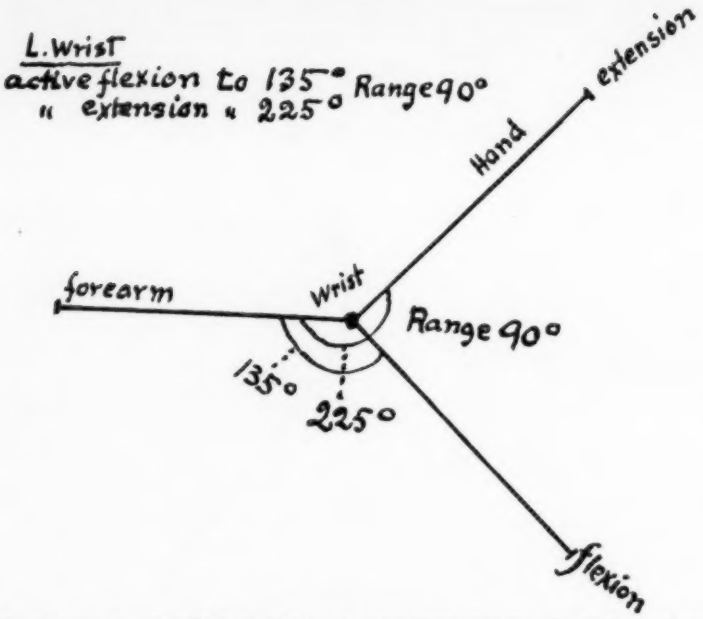

FIG. 5.—Diagram showing method of recording range of motion of wrist.

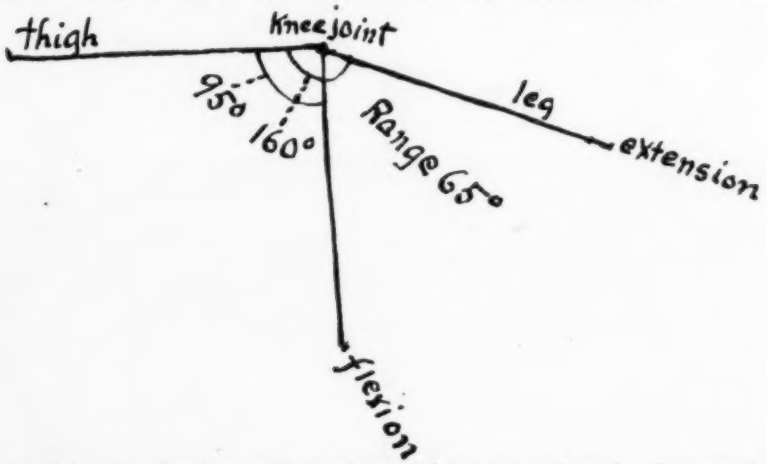

FIG. 6.—Diagram showing method of recording range of motion in knee joint. Right knee—Active flexion to 95°; active extension to 160°. Range 65°.

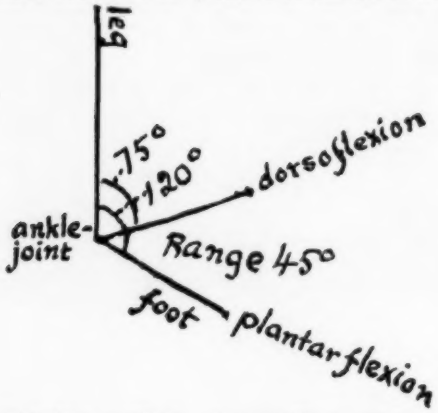

FIG. 7.—Diagram showing method of recording range of motion in foot. Right foot—Active dorsiflexion to 75°; plantar flexion to 120°. Range 45°.

Left Wrist:

Active flexion to 135 degrees
Active extension to 225 degrees } Range 90 degrees.

If the hand can be moved passively 10 degrees further in each direction, you tabulate the involuntary motion in the same manner:

Passive flexion to 125 degrees
Passive extension to 235 degrees } Range 110 degrees.

Figures 6 and 7 show the procedure in measuring the knee- and ankle-joint, respectively. If desired, diagrammatic drawings, such as here represented, may also be made, in order to facilitate the interpretation of the reports.*

Recording the Strength of Motion:

At the Clinic for Functional Re-Education in New York, where we have had considerable experience in making case records of joint deformities caused by gunshot wounds and industrial accidents, dynamometers are not used in routine mensuration of strength of motion at the various joints, excepting for the grip. This is registered by means of a simple contrivance having a compressible spring and a scale registering in pounds. In the other joints the strength of motion is compared with that of the corresponding joint of the sound side wherever possible, and expressed in percentages, counting the normal as 100 per cent. strong. This method has been found very satisfactory.

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*Printed charts, showing the extremities with range of movements marked in degrees, were issued by the Centre for Physical Treatment, Versailles, France, and also by the Canadian Government during the war. They proved a great help in elucidating the case-reports of disabilities.

SPINAL PATHOLOGY IN RELATION TO OCULAR MANIFESTATIONS, WITH REPORT OF CASES.

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As the outcome of the work done by Dr. Lloyd Mills and myself during the last five years has so satisfactorily proven the correctness of our original premises, and as we have established with comparative definiteness the relations between irritative lesions of the spine and eyes, it is desirable to consider the present status of this work and further conclusions to be drawn from it.

Both eyes and ears, as the chief channels of afferent sensation, play a very decided and important part, probably the most important part, in relating us to our environment, and also as a part of the position sensing mechanism. The tactile sensory machine with its end organs in muscles, joints, and skin, is almost equally important. It works in such close harmony with eye and ear that in certain phases of physical activity it is difficult to tell which is most important.

Probably there is no other example of this interaction so marked as that seen in "attending" to a given activity. Anything that obtains the attention of the mind does so by using one or more of the sensory paths to convey the continued stream of afferent stimuli to the brain. This in itself necessitates continued motor activity in physically controlling the pathways needed for the conveyance of such impulses.

For instance, suppose as the result of a mental stimulus you take up a book to read. In order to properly fulfill the motor expressions necessary to such reading a continuous stream of efferent impulses must flow to the muscle group involved in making reading possible. The hands and arms must hold the book at a given distance and angle, thereby calling into play the tactile end organs in the skin, muscles, and joints for information as to the position of the book in relation to the body; all the muscles of the body must maintain a fixed position in relation to the chair; the head must be stabilized in the proper position for the best use of the eyes—a position which would vary in accordance with the visual needs due to the physical condition of the eyes. This posture must be maintained constantly fixed so that no part will move or wobble and interrupt the stream of visual sensations

passing the sensorium. If a person were sitting listening to a speaker, there would be the same sort of adjustment necessary, except that the auditory pathway would be first in importance and the visual would come next.

In an activity involving coördinated movements, as in some occupations or games of skill, other pathways also would have to be maintained for the recognitions of sensations necessary to proper control. Fine balance control of the whole body, or any part of it, may be required also as a part of both the sensory and motor phases of any activity in which the mental attention must be carefully directed.

In orthopædic surgery we are rather apt to think only of the grosser aspects of muscle activity, such as the control of bony levers or the production or control of gross deformities. We thus overlook some of the finer phases of muscle physiology that involve the more delicate and intricate activities associated with varying brain states and necessary for the proper functioning of the finer parts of the body, as, for instance, the eye, ear, and speech mechanism. As has been previously pointed out by the author in an article,—"The Effect of Faulty Skeletal Alignment upon the Eye,"—which appeared in *The American Journal of Orthopædic Surgery* for December, 1918, and by Dr. Lloyd Mills in "The Effects of Faulty Cranio-spinal Form and Alignment upon the Eyes," which appeared in the *American Journal of Ophthalmology* for July, 1919, there is a very extensive and highly coördinated activity involving the whole position-sensing mechanism which includes the labyrinthine apparatus, the muscle groups, especially of the head, shoulder girdle, upper back and arms, and most of the rest of the body, as well as the organs of special sense, chiefly the eye and ear. When we realize that, aside from the usual duties of this complex position-sensing, balance-controlling, attention-fixing mechanism, our actual thought forces are constantly evidenced throughout our muscular system by the most delicate changes of muscle tension, we can see how in certain individuals it is easy to have produced those conditions of muscle and nerve strain which group under the symptom complex known as "postural strain."

Our muscles are actually "organs of will" and our thoughts and emotions are made known to the outside world only by the motor response to the stimuli from the will. Even the subconscious neural control of most of the automatic reflex acts has at one time been developed under conscious control, and by repetition certain habitual and automatic reactions have become established.

Static strain begins primarily as malfunction, but due to the continuance of such faulty function and to the production of the well-known vicious circle, actual changes in the tissues are gradually produced. These changes begin with ligamentous and muscle tension and are followed by cramp in the muscles (often a mild myalgia), effusion around the points of insertion of ligaments and tendons, fibrositis, periostitis, periarthritis, and arthritis.

"Neuritis," so called, is a usual accompaniment or result, and disturbances due to the involvement of the nerves in that locality frequently are so marked as to obscure the underlying condition, and often result in the treatment of the symptom and not the real condition. This fact has been especially noticeable in the group of cases under consideration. We frequently found that such symptoms as pain down the arm, "tingling," "numbness," "prickling" in hands, arms, and shoulder, had been treated for "neuritis" without further investigation of spinal or shoulder girdle form or alignment. The collaboration with an oculist, skilled in the methods of measuring ocular muscle imbalance, is essential in the treatment of these cases of cervical and cervico-dorsal lesions with irritative symptoms. It has been the means of bringing relief to a class of cases whose numbers are legion and with which every practitioner is more or less familiar.

When a patient comes in for sub-occipital aching or pain in neck and shoulders that is always made worse by any attempt at concentrated work, such as "sewing," "reading," "driving," or "bench work." it is useless to attempt to give relief by purely local means. Not only must the whole body posture be rectified, but an eye examination is always indicated. Before such a case can obtain permanent relief and benefit it is necessary to ascertain whether there are elements of the eye muscle imbalance and ocular strain increasing and causing the condition, or whether the relation of cause and effect is the other way round.

A reference to certain eye positions in torticollis was brought out many years ago by Gould, but as we have shown in previous papers, the question of the production of eye muscle imbalance, faulty eye function, chronic inflammatory conjunctivitis, glaucoma, etc., by irritative spinal lesions and postural faults, we feel has never been established previous to our findings in 1915.

The principal local lesions which we have found to be associated with this eye and balance complex are: cervical rib, typical and atypical; osteoarthritis in the cervical and cervico-dorsal region; fibrositic

deposits; scoliotic twists and curves; impingements of lateral processes, especially abnormally large or long seventh cervical ones; impingements of the posterior processes in cervical lordosis compensatory to antero-posterior spinal mal-alignment; and minor luxations or subluxations of one or more vertebrae with restrictions of normal movements of the parts involved.

The effect of these lesions on the eyes is unquestionably produced through the irritation of the cervical sympathetics. This is ably shown by Dr. Lloyd Mills in a paper read before the Eye, Ear, Nose, and Throat Section of the California State Medical Convention, May 20, 1920, entitled "Significance of Spinal Defects and Pain Occurring in Relation to Ocular Diseases." The same effect may also be produced through nerve strain and irritation of the labyrinthine mechanism which is so intimately involved both in eye activity and in balancing function of the muscle groups used in fixing the shoulder girdle, neck, and head. It thus acts as part of the visual apparatus, as pointed out in a previous paper.

Aside from the effect on the eyes due to direct irritation, there are undoubtedly gross effects, produced by strain in this visual balancing function, due to gross faults of spinal alignment. Another more indirect effect is that due to the increased neural effort which mal-alignment and the lowered muscle tone makes it necessary to expend to accomplish a given act that normally could be done with much less effort.

We also feel sure, from certain facts brought out in the treatment of spastic paralysis cases with athetoid movements and in certain habit spasm cases, that not sufficient consideration has been given to muscle fatigue and the toxaemia incident to it. Muscle groups which are required constantly to maintain fixed postures will necessarily be unduly fatigued when they have to overcome skeletal faults and compensate for irritative lesions by having to guard sore and sensitive areas. Now, as the control of so many muscular reactions is entirely reflex and the neuro-motor mechanism involved must be delicately susceptible to all changes in nervous states, we feel that these fatigue toxins increase the excitability of the reflex arcs and tend to keep up vicious over activity of the corresponding muscle groups. When such muscle groups as are concerned with the delicate functions of vision, audition and the finer coördinated movements of hand and arm are involved, the resultant overwork adds to the burden which is ultimately evidenced as strain, pain, and dysfunction.

In considering these local cervico-dorsal lesions, I should like to call

attention to the close analogy in the defects themselves as well as the symptoms produced, to similar states existing at the lumbo-sacral area where faults of form and alignment are so common. I should like to say in this connection that I consider a large percentage of the so-called "sciatic neuritis" cases to be due to exactly similar factors as occur in the neuritic types of cases in the shoulder girdle area which are under discussion. The author, who has experienced a traumatic strain of the right sacroiliac, followed by chronic irritation and soreness in that area ever since, has recently found on analysis that a constant aching of the right side of the pelvis, back and hip, noticed so often while driving an auto, really resulted from using the foot throttle. You can readily see that to expect the larger muscle masses of the foot and leg to keep up so fine a balance extension and flexion of the foot, requires the fixing of the femoro-pelvic muscle groups which extend into the lower back. This is an *attention* strain exactly like what occurs in holding a book still enough for the use of the eyes.

We see a similar action of reflex sympathetic irritation through the sacrosciatic plexus, involving frequently the pelvic and abdominal organs. Often this is evidenced by the relief and by the improved function in pelvic viscera when the spinal alignment is improved and local strain eliminated. The reverse is also true, *i.e.*, backaches and low-back pains are relieved when pelvic irritations are removed. Frequently conditions involving one plexus may be frankly transferred to another. It is not unusual to have patients, who come for postural faults of the lower back, feet or legs, state after their correction, that they notice marked improvement of the eye condition. We commonly see, also, a decided improvement in the function of the abdominal viscera after a correction of the spinal alignment. Similarly through the sympathetic reflexes we also know that certain ocular conditions can produce nausea.

I will briefly mention a few cases in which the radiographs show spinal defects, in order to illustrate the types of conditions found in connection with eye findings and will cite a little more fully a representative case to show the resulting benefit to the eye condition from the correction of a lumbar scoliosis referred to me for sciatica by a specialist on tuberculosis.

Case 1. Miss G., aged 35 years. Entered October 4, 1915. Diagnosis: Scoliosis, right dorsal, left lumbar, with pronation and depressed arches. Bronchitis for several years—incipient tuberculosis—had been

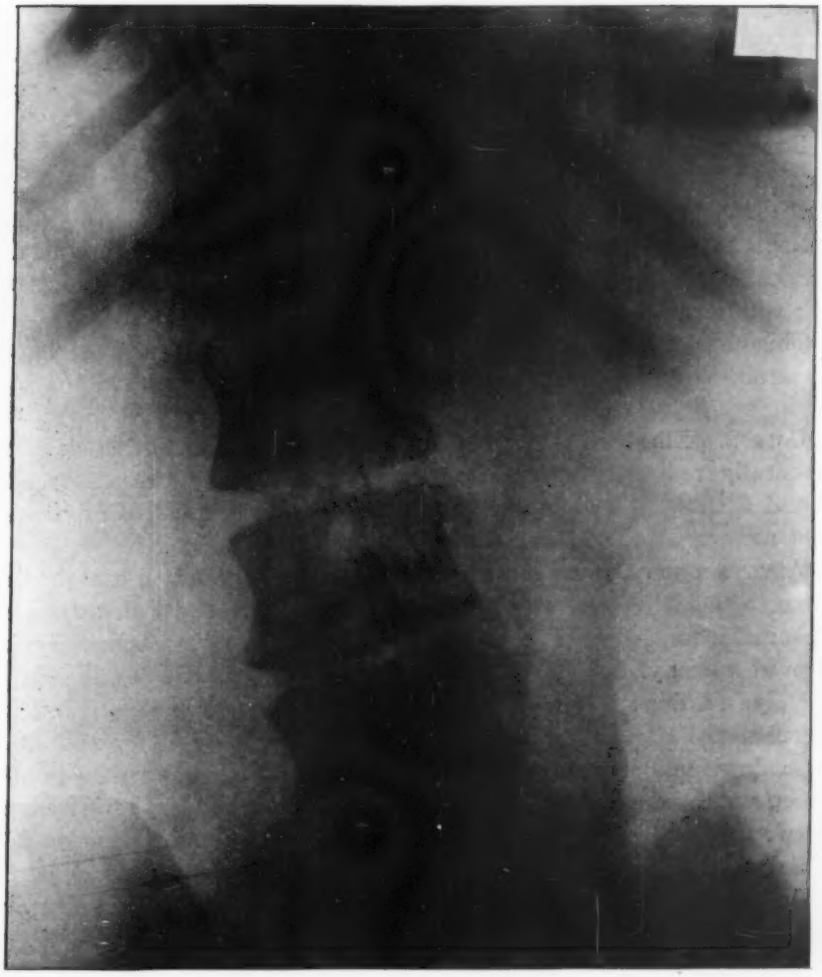


FIG. 1.—Miss G. Age 35. Diagnosis scoliosis—with secondary neuritis—sciatic and cervico-dorsal.

at sanitarium for five months—much improved chest condition. Pain in lower back, worse during menstruation—constant pain just below the waist. When she sits up quickly in bed after lying on back, has sharp pain and crepitation in the left sacro-lumbar region. After standing up, pain is radiated to the left as far as the crest, but not down the leg—neuritic symptoms over neck and shoulders—plumb line from mid-heel passes one inch to the left of the nates—left posterior superior spine one inch lower than the right—right dorsal left lumbar

curve—left leg about one-half inch shorter than the right. Scoliosis was very nearly corrected by five modified Abbott jackets followed by brace and exercises; back symptoms all relieved—condition very good at present—eye condition changed very markedly.

Examination of the eyes February 26th, 1916, showed following condition: Left hyperphoria, 1°; exophoria near ½°; esophoria 1¾°; abduction, 3°; adduction, 7°.

Report of April 20, 1920, as follows: "Miss G. has, at this date, a vertical and lateral orthophoria. Exophoria for near 4°; abduction, 4°; adduction 30°.

This constitutes a perfect balance. Her eyes have lost all appearance of strain and irritation." Report from Dr. Lloyd Mills.

CASE 2. Elizabeth B., aged nine years. Entered March 4, 1919. Generally relaxed posture in a chunky girl, slightly overnourished—round shoulders—hollow back—very nervous, with muscular twitching and nervous stability poor—fatigues easily.

After six months of corrective work mother informed me she had gone to their optician who sent me word that she had reduced an exophoria from 20° to 7° by June, 1920, and was very markedly improved visually.

"Eye findings December 13, 1920, showed esophoria 3.00; left hyperphoria, 2.00. Prisms swung to 60°. O.D. base up and in, O.S. base down and in as a temporary expedient awaiting further tests to ascertain if improvement is permanent. The left hyperphoria reduced between October 8, 1920, to December 13, 1920, from 7° to 2°." This was a report from Dr. E. A. Hutchinson.

In January, 1921, she was allowed to discontinue active supervised work because of improvement to so satisfactory a condition.

CASE 3. Mrs. H. Patient came in from Nevada in March, 1919, for treatment of anterior metatarsalgia and asked to be referred to an oculist because she was having trouble with her eyes. Her feet were padded and she returned in ten days, stating that she "wouldn't have to go to an oculist as her eyes were O.K. since pain in feet was relieved."

Reported January, 1921, that she had had no further neuritis or eye trouble.

CASE 4. Mrs. D. C. Entered February, 1918. Diagnosis: Anterior

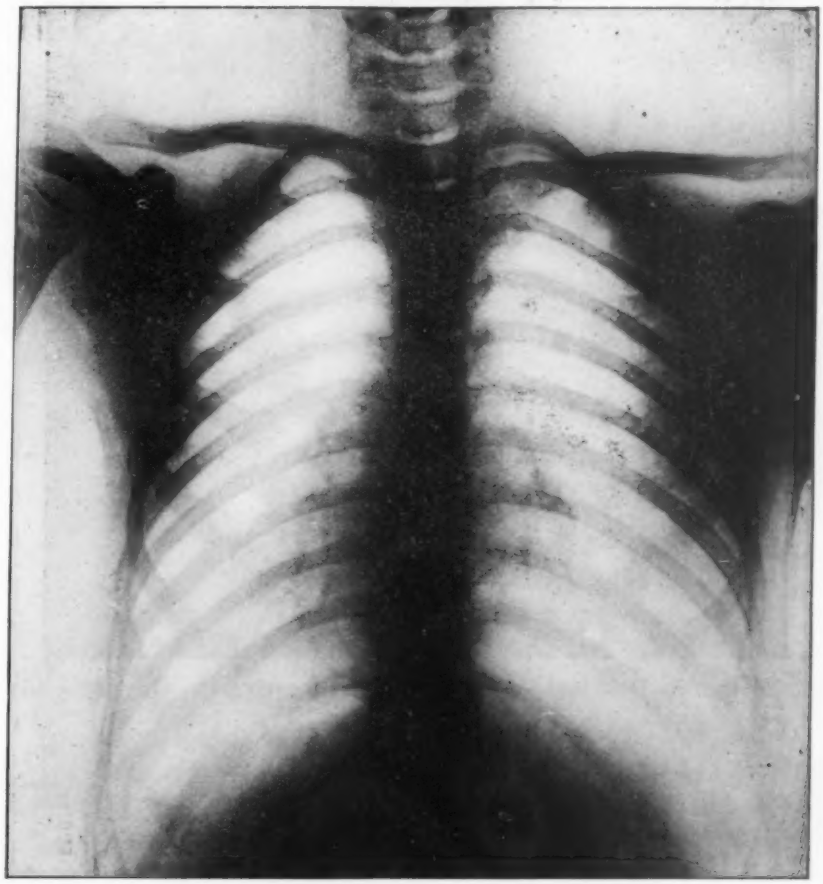


FIG. 2.—D. S. Age 8. Torticollis—with marked muscular eye imbalance. Note difference in height of clavicles.

metatarsalgia and postural back strain. History showed severe eye trouble for years. After static correction, she began to see well enough to sew again. Sprained ankle and went on crutches. Eyes immediately became worse, and improved when crutches were discontinued.

Dr. Forgét, her oculist, reported subsequently that eye condition was markedly improved, due to improvement of muscular imbalance. Patient died of "flu" in 1919.

CASE 5. D. S., aged eight years. Diagnosis: Torticollis. Entered September, 1919. Eye findings showed characteristic muscle imbalance

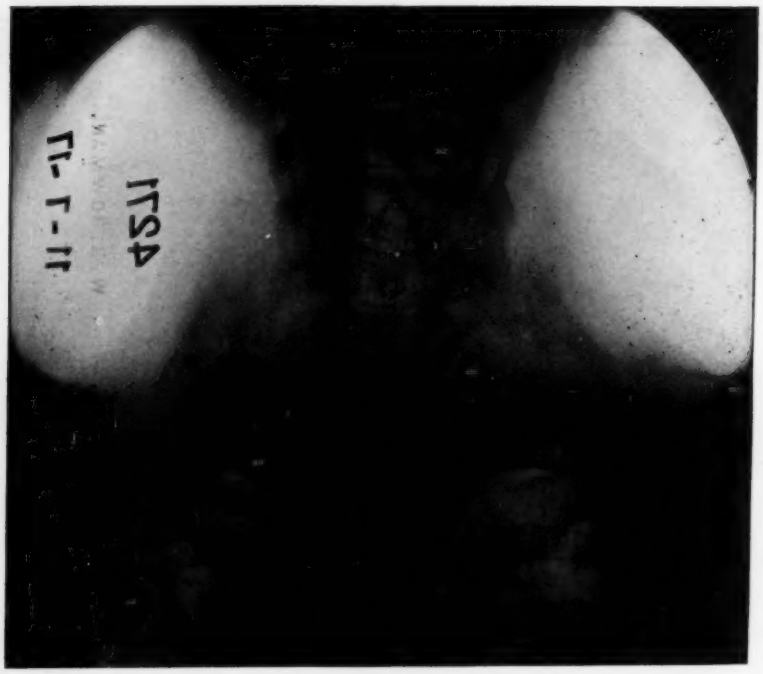


FIG. 3.—Mrs. L. Diagnosis—Cerv. neuritis and postural strain. Eye—Diag. sympathetic conjunctivitis.

as follows: Abduction, 6°; adduction, 1°; L. hyperphoria, 1½°; exophoria, 4½°; exophoria near 10-13; visual acuity, 6/6. Mother refused operative correction until after trying Christian Science.

CASE 6. Mrs. L., aged 40. Diagnosis: Cervical neuritis and postural strain. Referred by oculist for neck symptoms—old history of typhoid and questionable spinal trouble afterward—formerly diagnosed as neurasthenia—eye condition a chronic conjunctival congestion without secretion, which was entirely relieved in three months of corrective treatments, balancing by means of shoes and corrective corsets, local massage, hydrotherapy and manipulation — chiefly traction — followed by active-passive exercises. X-ray showed scoliosis and especially cervical lordosis.

CASE 7. Miss J. H., aged 28 years. Entered December 13, 1915. Complaint: Pain in back of neck. Her history shows that she was extremely sensitive to noises—very nervous—slept poorly—concentration

FIG. 3a.—Mrs. L. Lateral view. Marked cervical lordosis and slight hypertrophic changes.

caused increased pain in neck—the glasses which she had did not relieve the nerves. She went to an osteopath ten years before for pain in neck. He manipulated neck, causing it to snap—obtained some relief, and found she could "snap" it herself, which she kept on doing, with a development of marked fibrositis, for which she was sent to us. Treated by fixed immobilization, then Thomas collar, corrective corsets, massage, traction, hydrotherapy, corrective exercises. Her oculist in Riverside reports her "a changed individual, no longer neurasthenic, and eye condition almost entirely relieved."

CASE 8. Miss T. Referred by oculist December, 1919, because of sensitive spots in cervical and cervico-dorsal areas—spells of blindness and a sore place on the occiput. Patient had been tubercular for some time, and examination showed badly relaxed posture. X-ray of spine showed a decided cervico-dorsal scoliosis—neck shorter on the left—seventh cervical vertebra tilted sharply downward to the right.

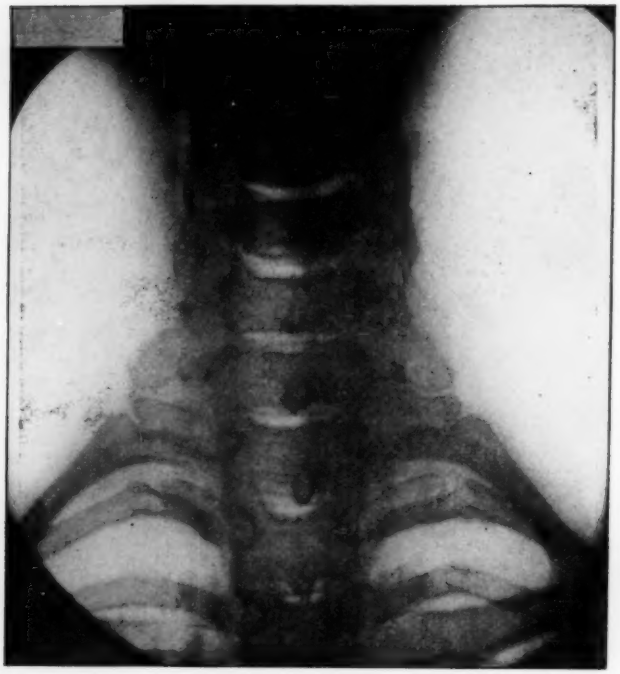


FIG. 4.—Miss J. H. Osteoarthritis cervical region. Large lateral processes of seventh cervical.

Pulmonary condition became so much worse very soon after treatments were begun that patient had to leave for sanitarium.

Such clinical and x-ray findings, however, in a case with eye symptoms are quite usual and strongly suggestive, in the light of other cases, that the connection is more than imaginary and it is mentioned to call attention to that fact rather than as an end-result.

CASE 9. Miss O. W. Referred to us by Dr. Kelsey on October 25, 1920, because of her recent development of eye-strain symptoms and pain and tenderness in neck, made worse by eye work of any kind—often "has to hold head while writing or reading"—uses a small pillow under her neck while resting.

The salient facts in her examination were as follows: Undernourished type—generally relaxed posture—relaxed sacroiliac joints—sensitive to pressure over left suprascapular region—fibrous crepitation over posterior processes of fifth, sixth and seventh cervical vertebrae elicited by palpating finger—stands in a very flat back position—left shoulder

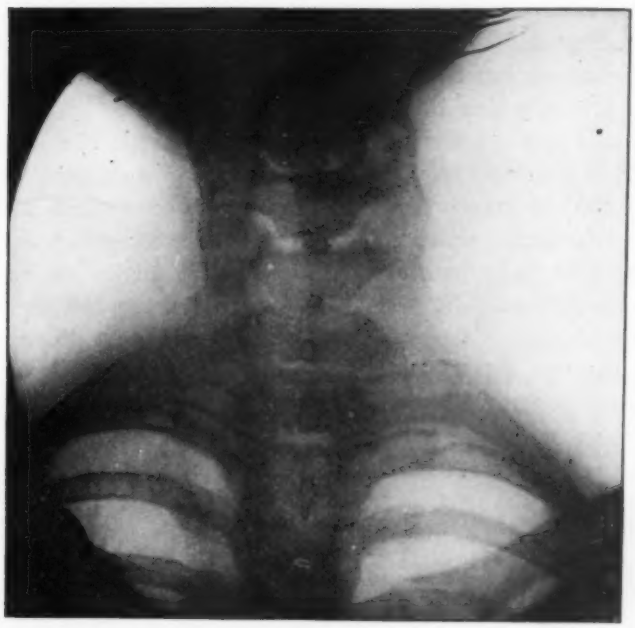


FIG. 5.—Miss T. Cervico-dorsal scoliosis with infringement of lateral process of seventh cervical.

higher than the right — moderately flexed scapulae. Diagnosis: Generally relaxed posture; subscapular bursitis. Treated by corrective shoes and high-backed, back-lace corset with shoulder straps, baking and massage, and mild stretching.

Patient reported on January 14, 1921, "greatest relief from lessening of tension which she formerly felt when reading, or looking at scenery or a moving picture."

Following report received from Dr. Kelsey, February 24th, 1921: "In the case of Miss O. W., I find that the esotropia has fallen from 15° prism to 10° for distance, and at times the diplopia for the near point is controlled, but there is in reality 10° esotropia at near point."

CASE 10. Mrs. K. Entered February 8th, 1921. Wife of a San Francisco physician, who referred her to Dr. Mills and myself because of a paretic condition of the pupil of the left eye, which condition began two years ago after a period of intensive piano practice of four hours a day.

Case had been diagnosed as encephalitis, but husband couldn't agree with that diagnosis.

Ocular examination found "no faults in vision and the pupillary condition probably due to sympathetic irritation."

Orthopædic examination showed moderate static faults — one-half inch short leg — long, round back — drooping shoulders, with heavy breasts — marked crepitation under upper inner angle of scapulae, worse on left, and palpation discovered flexed scapulae with marked sensitiveness to deep pressure throughout the region of the superior angle of the left scapula, extending toward the seventh cervical. The x-ray showed rather large lateral processes of seventh cervical, unequal on the two sides. Diagnosis: Subscapular bursitis.

Treatment began with massage and relieved at first, but within a week pain became worse and adhesive strapping immobilizing the scapulae gave relief—correction of posture by shoes, corsets and special brassiere.

The especial point of interest thus far is that under rest the pupils become equal.

OPERATION FOR HYPERTROPHIED PATELLA.

BY GEORGE E. BENNETT, M.D., BALTIMORE, MD.

Hypertrophied patellae are most often the result of comminuted fractures that have united firmly with a marked increase in the length and breadth, but not infrequently they are the result of a vigorous manipulation of the knee with a resulting fracture of the patella at the attachment of the patellar tendon. The small fragment that is separated unites in a position that increases the length of the patella. Infections, such as primary osteomyelitis and osteomyelitis secondary to patellar bursal infections, and severe strains also cause the condition.

Fortunately the enlarged patella seldom gives any annoying symptoms. The usual signs are the increase in length and breadth of the patella, a knee that is somewhat limited in flexion, but is a painless and well-functioning joint. However, one does see individuals, who have a disabled and painful knee with marked synovial thickening, which is the result of constant trauma from a patella that is too long and broad. This type also has a considerable loss of function, particularly the inability to flex the leg beyond seventy or eighty degrees without pain, having a great deal of discomfort when attempting to go up and down grades and walking up and down stairs. The symptoms will all disappear under rest, to recur with use.

Many such cases have been operated on and the thickened synovial membrane removed with temporary relief of symptoms. The writer has had several such experiences, but obviously any procedure of this type is palliative surgery, as we in no way remove the cause and may expect a recurrence of signs and symptoms. Inasmuch as the enlarged patella is the cause, we have attempted to develop an operation which will reduce the patella to its normal size, and the results have been very satisfactory.

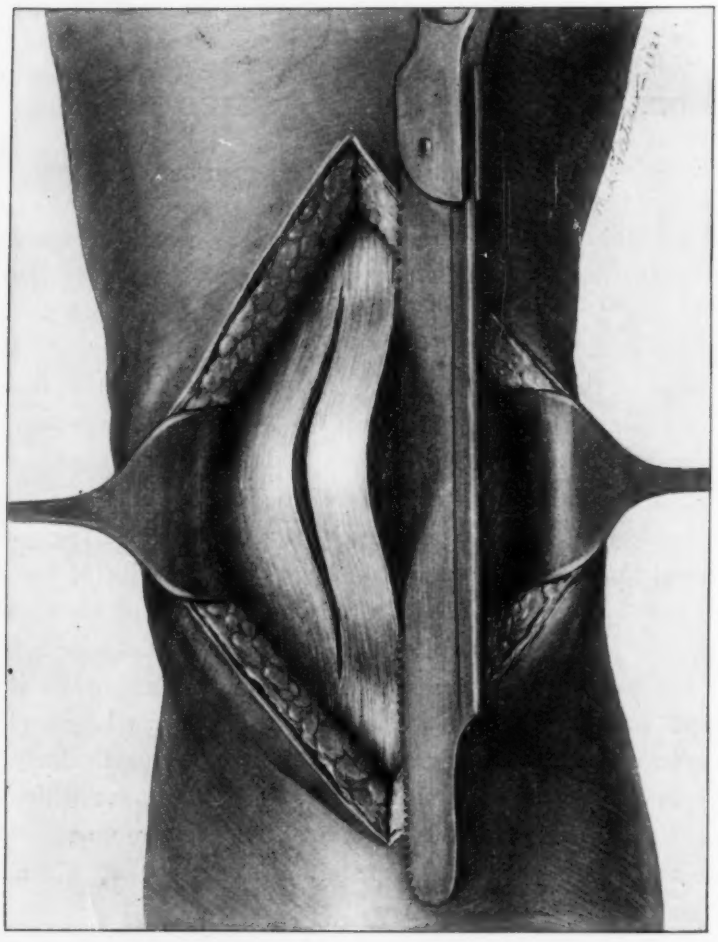


FIG. 1.—Exposure by linear incision extending from the midportion of the patellar tendon over the patella and exposing the attachment of the quadriceps. The central section of the patella to be removed is marked by a scalpel, and with a thin saw is cut three-fourths of its depth. At this depth the patella can be "cracked" by an osteotome, or, as shown in the cut, by lateral pressure on the saw blade. This detail of technique prevents small particles of bone entering the joint.

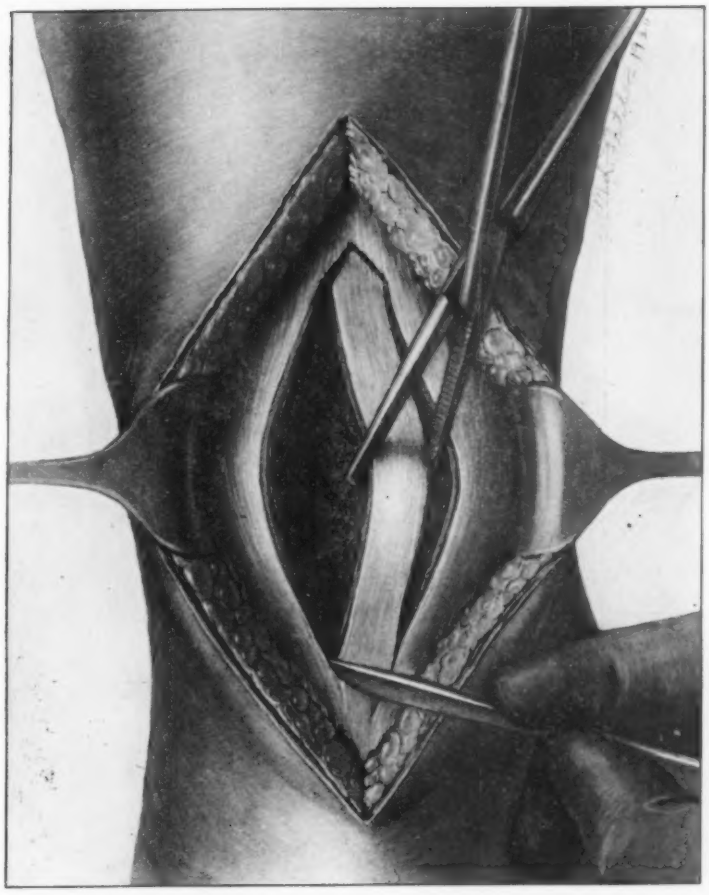


FIG. 2.—Removal of central portion. A V-shaped cut in patellar and quadriceps tendons insures easy closure.

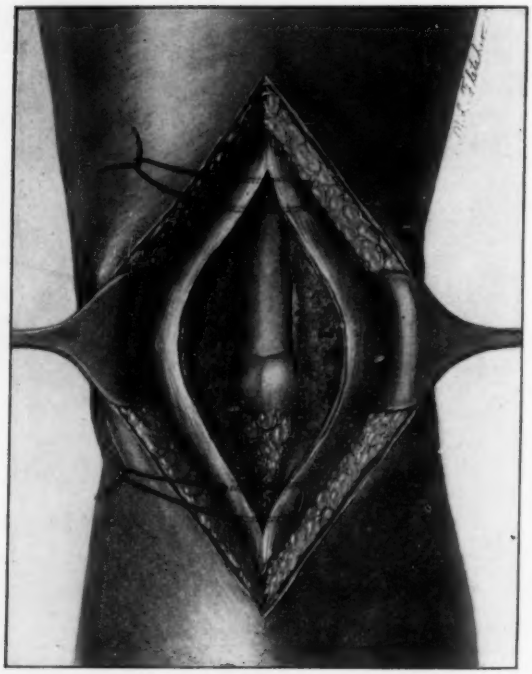


FIG. 3.—Mattress sutures of heavy kangaroo tendon in the patellar and quadriceps tendons.

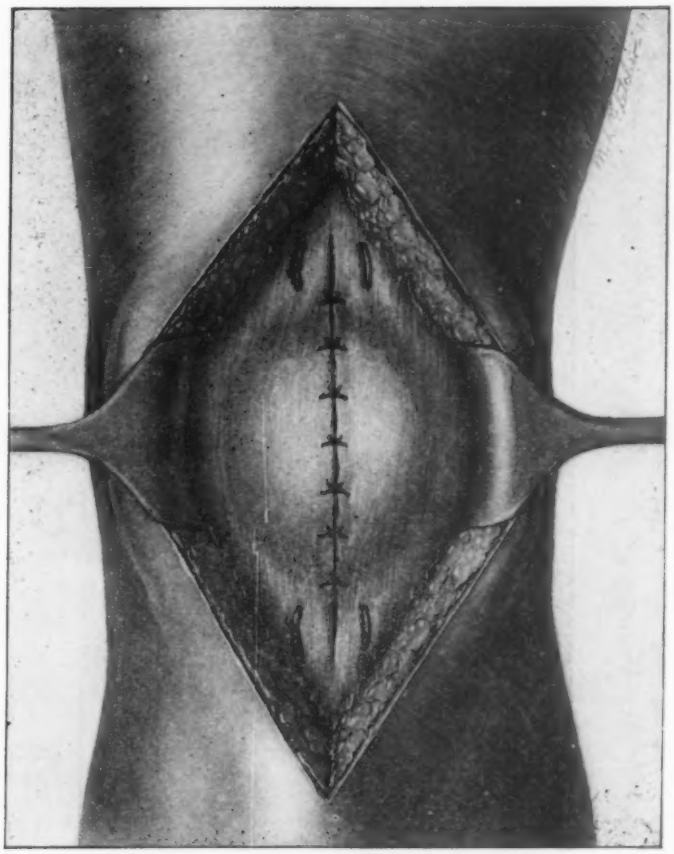
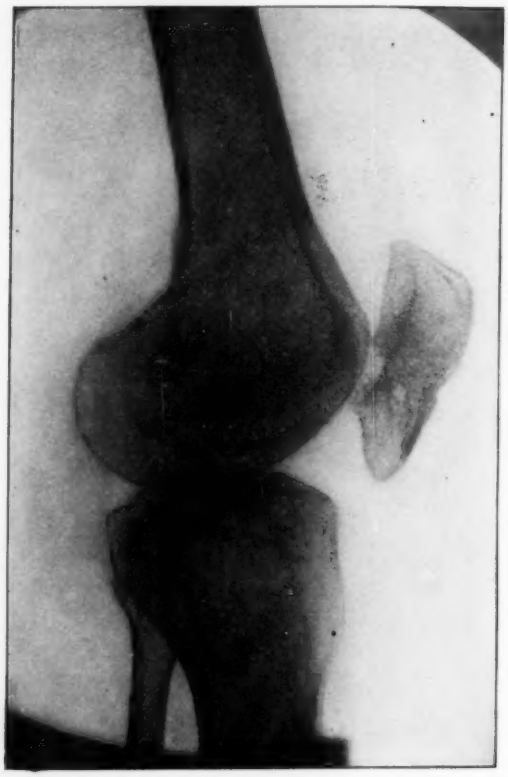


FIG. 4.—Chromic catgut to close fasciae over the patella. It has not been found necessary to place any suture through the patella.

Post-operative treatment: Leg immobilized in full extension for two weeks; active and passive exercises the third week, and patient permitted to walk at the end of the third week.



X-RAY A.—Old fractured patella with hypertrophy, giving marked symptoms, which was operated on successfully.

X-RAY B.—Old injury and fracture of patella in young individual, producing marked synovial irritation. Was operated on successfully.

A detailed case report is unnecessary. The operation has been in use several years and is satisfactory. The accompanying illustrations show the two types of cases that have been operated upon with satisfactory results.

A CLINICAL AND EXPERIMENTAL STUDY OF THE FREE TRANSPLANTATION OF FASCIA AND TENDON.

BY W. E. GALLIE AND A. B. LE MESURIER, TORONTO, CAN.

THE transplantation of fascia and tendon for the repair of various anatomical defects has been recognized for some years as a useful surgical procedure. Experiments by numerous investigators have shown that when the fibrous tissues are cut free from their circulation and transplanted to another position in the same animal, they may be expected to survive the operation and retain their normal gross and histological characteristics. The principle has never come into general use, however, owing to the variability of the firmness with which such transplants heal to the surrounding tissues. It was with the object of overcoming the uncertainty of the results obtained in these operations that the research referred to in this paper was undertaken, and we are now in a position, after a thorough clinical test of the principles involved, to report definite progress towards making the transplantation of the fibrous tissues a more valuable addition to operative surgery.

A preliminary report of the experimental investigation has already been published,[1] but it will be necessary, before referring to their clinical application, to review briefly the results of our research. Our attention was directed, in the first place, to the simple healing of the fibrous tissues. Under the name of fibrous tissues are grouped tendon, fascia and aponeurosis, which are essentially the same kind of tissue. They consist of wavy parallel lines of heavy white fibres between which are situated a few flattened cells (tendon-cells). In tendons the fibres are grouped into stout cords, while in fascia and aponeurosis they are arranged in thin sheets. In all three the surfaces are covered with a delicate areolar tissue in which the blood-vessels ramify. The fibres are divided into irregular bundles by processes of this areolar tissue which extend inward from the surface and carry minute blood-vessels and lymphatics to the deeper parts.

Experiments were performed in which transverse and longitudinal incisions were made in fascia, tendon and aponeurosis, and closed with absorbable and non-absorbable sutures. In some the edges of the fibrous

tissue incised were simply brought into close apposition; in others the edges were overlapped. The specimens were recovered at weekly intervals up to several months. In the early stages the area of the operation shows an ordinary inflammatory reaction. The blood-vessels, which run in the areolar tissue on the surface of the fascia or tendon, are engorged and the tissues are covered with a plastic exudate consisting of fibrin, cells, and serum. At the end of two weeks the process of repair is at its height. The exudate has become filled with proliferating connective-tissue cells and leucocytes, and the growth of new blood-capillaries has converted it into a granulation tissue. It would appear that the tendon-cells and fibres take little or no part in these proliferative changes, and that the new connective-tissue cells are derived from the areolar membranes on the surface, and in the interstices between the groups of fibres. At the end of three to four weeks the cellular activity has subsided and the line of the incision is filled with delicate irregularly-arranged branching fibres. As time goes on the fibres become thickened and the cells and new-formed blood-vessels largely disappear. When the process is completed the sheath on the surface has been restored to normal and the line of the incision is healed together by ordinary connective tissue.

These observations in regard to the character of the healing in the line of the incision are of great importance from a clinical standpoint. They explain the uncertainty which attends the healing of tendons after subcutaneous tenotomy, and the frequency with which the abdominal aponeuroses separate after edge-to-edge suture for the cure of ventral hernia. If the repair of wounds in these structures is to depend on such material as areolar and scar tissue it is only natural to expect that if the line of union is subjected to severe degrees of strain, the edges of the wound will gradually separate. In many of our experiments this actually occurred, particularly when absorbable sutures were employed. It occurred frequently, however, even when silk or linen was used, owing to the cutting out of the sutures. This tendency to separate was considerably reduced by overlapping the edges of the incised fascia or aponeurosis, as is done in the ordinary operation for ventral hernia, and by making a step-tenotomy in the case of tendon. By this means the area of the healing surface was enlarged and the amount of areolar or scar tissue forming in the line of union correspondingly increased. In order that this overlapping method may be at all effective, however, it was found that the surfaces placed in contact must be completely deprived of their sheath of areolar tissue, otherwise the strength of the

union will be very slight. Such surfaces should be thoroughly scraped and scarified in order that when healing does occur the new connective tissue may have a deep grip among the fibres. The importance of these observations is well demonstrated by the uniformity of the success which attends step-tenotomies, and by the frequency of the failures which result from attempts to make side-to-side sutures of severed tendons. They indicate that in all operations in which it is intended to unite any of the fibrous tissues, these tissues must be placed in actual contact with each other over a sufficient distance to make certain that the connective tissue, which forms in the line of union, will be sufficiently strong to withstand the anticipated strain. This means that, in the case of aponeurosis and deep fascia, the edges should be overlapped, and in the case of the tendons, when tenotomy is performed, some form of step-operation should be employed. In the implantation of tendons into one another it is essential that raw surfaces shall be brought together, and this is the best accomplished by some method in which a portion of the split end of one tendon is passed through an incision in the other, or in which they are actually woven together as in the splicing of a rope.

FIG. 1.—Method of Healing of Tendon to Bone. (1) Tendon, consisting of regular parallel fibres. (3) Bone, and (2) New-formed scar tissue, consisting of irregularly arranged fibres uniting the two.

Our investigations also included a study of the healing of tendon to bone. Some years ago we described a method of converting the tendons of paralyzed muscles into ligaments which would prevent the occurrence of deformities.[2] Since the introduction of this method surgeons have frequently reported to us that the new ligaments have pulled out of their beds in the bone and that the deformities have recurred. In our own earlier cases this did happen occasionally, but after we realized the nature of the union which can be expected between tendon and bone, the failures from this cause were soon eliminated. The healing of tendon to bone takes place in precisely the same way as the healing of tendon to tendon, that is, by the formation of new connective tissue which adheres to both tendon and bone (Fig. 1.). If the tendon is placed in its bed, without the removal of the areolar membranes, the fixation can be no stronger than are these areolar membranes. Naturally the tendons will pull out. To make certain of a solid fixation it is necessary to scrape and scarify the tendons until actual contact with the walls of the trough in the bone is assured, and we have found that if the tendon is split so that its raw surface comes in contact with bone, and if this contact is provided for over sufficient length of surface, the fixation will withstand any degree of physiological strain. These observations indicate the unwisdom of depending, in tendon-transferences, upon suture of the end of the tendon to periosteum or laying it in a short groove in the bone. The only safe method of fixation consists in passing the scraped or split end of the tendon through a suitable hole in the bone and fastening it in place until complete healing has occurred.

With these facts established, in regard to the simple healing of the fibrous tissues, we proceeded to a study of the healing of transplants. Our experiments corroborated those of previous investigators in showing that, when fascia, tendon or aponeurosis is transplanted in the same animal, it will continue to live practically unchanged. If the transplanted tendon is very thick the central portions will degenerate, which indicates that, if the nature of the operation requires tissue of the strength of thick tendon, the transplant should be freely incised or split, in order that the lymph may reach its deeper parts. These transplants heal to the surrounding tissues in quite the same way as do the fibrous tissues whose circulation has not been disturbed. The line of union becomes filled with new connective tissue, and over the whole area of the operation grows a new areolar film which closely resembles the normal sheath. It is thus apparent that transplants of fascia, tendon,

and aponeurosis can be used successfully to fill defects in the fibrous tissues, but that the method of healing will be quite as unreliable as when they are closed by simple suture. This was demonstrated in numerous experiments in which gaps in tendon were bridged with tendon or fascia, and in which patch transplants were introduced into defects in fascia or aponeurosis. Quite frequently the connective tissue in the line of union stretched and so allowed the effectiveness of the operation to be destroyed.

As the occasion for using transplants of the fibrous tissues usually arises in conditions in which considerable strain on the part is anticipated, it is evident that, to make the method effective, some more certain means of securing firm union must be discovered than that provided by edge-to-edge suture. Even the precaution of scraping the areas which are in contact, and overlapping the edges, is not sufficiently trustworthy when one considers that the whole outcome of these operations depends on the firmness of the healing. When one wishes to unite the transplant to bone, the problem is not so difficult, for here it is only necessary to follow the principle already enunciated, namely, to bury the scarified or shredded end of the transplant in a long tunnel in the bone. But in the case of large defects in aponeurosis or tendon, such as occur in wide ventral hernias, or in wounds or burns involving tendons, the outlook is not so certain. It is just in these particular cases that the transplantation of fascia and tendon has so frequently failed and so earned an unwarranted disrepute. In an attempt to solve this problem we did a series of experiments in which strips of fascia were removed from the animal's back and then carried transversely across the gap so produced and woven several times into the edges. At each of the slits through which the transplant passed, catgut or linen sutures were inserted. This method proved to be a great improvement on edge-to-edge suture, and also on the method of overlapping the margins. It had the disadvantages, however, that it was a tedious operation to perform, and also, that it did not completely exclude the possibility of stretching of the connective tissue in the line of suture. The trial of the method, however, led to an idea which has completely solved the difficulties in the way of using the fibrous tissues as transplants, namely, the idea of threading the transplants on needles and using them as living sutures. By this means the transplant can be woven securely into the surrounding tissues and mechanically anchored so firmly into them that it is no longer necessary to depend upon the doubtful strength of the scar tissue. The surgeon now

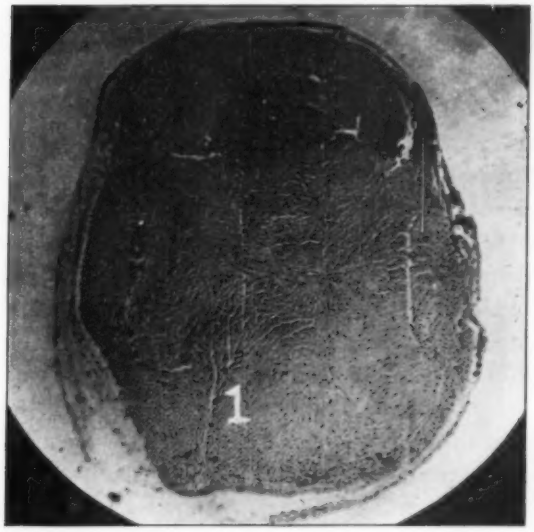


FIG. 2.—Cross-section of Fascial Suture after One Year. The suture is now a round cord closely resembling tendon. It consists almost solidly of parallel fibres, with a few vascular areolar-tissue trabeculae (1).

depends solely on the strength of the suture itself and of the tissues into which it is woven.

Before employing the method clinically we did a series of experiments in which gaps in fascia were fastened together with these living sutures. The specimens were recovered at weekly intervals and they showed that the sutures behaved exactly as did the transplants already described. They continued to live practically unchanged and healed to whatever structures they were woven into, by new connective tissue. At the end of the second week new blood-vessels could be seen with a glass, growing along the surface of the suture, and by the end of the third week they could be followed with the naked eye. In the succeeding weeks the primary inflammatory phenomena subsided and left the sutures as white rounded cords, which bridged the gap in the fascia and held its edges at the same distance from one another as at the time of the operation. Cross-section of specimens recovered in the early weeks showed the folds of the fascia separated by layers of areolar tissue, which were continuous with a similar layer which formed on the surface, but, as time went on, these new trabeculae contracted so that they were scarcely distinguishable, and the suture had the exact appearance of a sectioned tendon (Fig. 2.).

In order to test further the clinical value of this method we did one set of experiments in which the strength of the sutures was recorded, at various intervals, after the operation, and another in which the length of the sutures was accurately measured at the time of the operation, and again at the autopsy. These experiments showed that the strength of the sutures remained practically constant and that neither stretching nor contracture occurred after the transplantation.

From our experimental and clinical work a few points in technique have been elaborated which may prove of value. Our sutures are practically all made from fascia lata, which is very strong, and is plentiful. A long incision is made on the outer side of the thigh, and the fascia roughly cleared of fat and areolar tissue. Two small longitudinal incisions, a quarter of an inch apart, are made in the fascia, which is then ripped to the required length with a pair of scissors. As many sutures as are required are thus prepared without detaching the ends, and the skin drawn together over them until the field of the principal operation is completely prepared. One end of a suture is then cut free and threaded into a large-eyed needle and tied securely with catgut. This precaution is necessary as the sutures constantly tend to slip out of the needle. The suture is then lifted out of its bed and a catgut ligature tied about its terminal end. The needle is now passed through one of the structures it is proposed to sew together, and then through the terminal end of the suture. In this way a slip-knot is made, which, when drawn taut, provides a perfect anchor (Fig. 3, (1)). Sometimes we make doubly certain of the security of the anchor by taking another stitch with the needle and passing it through one of the parts of the slip-knot. The surgeon may now proceed with his sewing in the ordinary way, but it is usually necessary, owing to the slippery character of the suture, to make an occasional lock-stitch. This may be done by transfixing the suture with the needle after passing it through the edge of the gap, or better, by looping the suture into a single knot. (Fig. 3, (2 and 3)). When the end of the suture is reached it may be terminated at once or lengthened by fastening another suture to it. This latter is done in the same way as one fastens together two leather thongs or two lacrosse guts, as illustrated in the diagram. (Fig. 3, (5 and 6)). To terminate the suture we usually split the end which is attached to the needle into two strands, and tie these about the main suture in a tight knot. (Fig. 3 (4)). This knot is finally transfixed and tied with a ligature of catgut. These precautions are very necessary, as the knot has a marked tendency to untie and allow the suture to become loose.

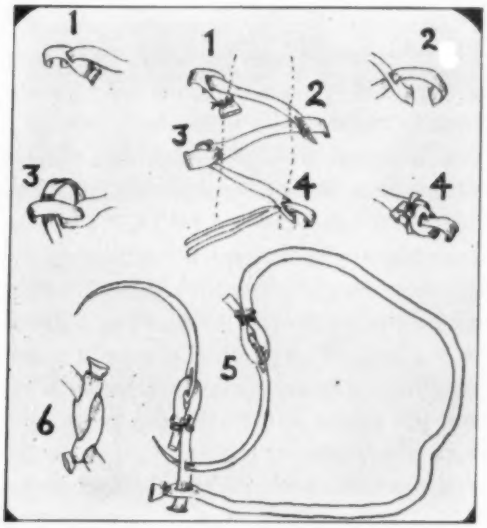


FIG. 3.—Technique of Insertion of Fascial Suture. (1) Method of starting the suture. (2) and (3) Method of preventing slipping at each insertion by either simple transfixion or by transfixion combined with a single knot. (4) Method of ending the suture by transfixing, splitting and tying both ends. This knot should be reinforced by a transfixion suture of catgut. (5) Method of uniting a fresh suture to one that has been expended. (6) Join completed.

The principles derived from this research have already been applied to a great variety of conditions in the realms of both general and orthopaedic surgery. In a general paper, such as this, it is impossible to do more than review these conditions briefly, and to leave to other publications the exact description of the operations performed. Something may be said, however, to indicate the way in which the method can be applied to the various fields.

Some years ago we had several cases of hallux valgus in which the deformity was so severe that we had little hope of being able to prevent its recurrence. One had already been operated upon and the abduction of the toe had recurred so badly that the patient had returned with a request that we make an attempt to correct it. In these cases we removed a strong strip of the extensor proprius hallucis tendon and passed it through holes in the base of the first phalanx and the neck of the first metatarsal so that it formed a new internal lateral ligament. The deformity was corrected and the ligament drawn taut and fastened with catgut. Nine years have now elapsed since the first operation was per-

formed and in no case has the valgus recurred. Such an operation is, of course, quite unnecessary in the great majority of cases of hallux valgus, but for those extreme cases in which the great toe lies transversely across the others it offers a sure method of restoring the foot to something more nearly normal.

Recurring lateral dislocation of the patella is a condition for which many operations have been devised, but which frequently eludes all our efforts to overcome it. In the autumn of 1917 a soldier came into our wards with such a dislocation, for which a plication of the capsule had already been tried unsuccessfully, and his disability was such as to render him totally unfit for service or for earning a living. In this case an operation was performed in which the patella was forced back into its correct position, and tethered there by a heavy new ligament, which was obtained from the tendo Achillis of the same side. This ligament was passed through a hole placed transversely through the patella, and then through a hole in the internal condyle, which was so placed that it lay in the centre of the circle through which the patella described its arc of motion during flexion and extension. The tendency of the patella to spring back to the lateral aspect of the thigh was so great that it had to be held in place till the plaster had been applied and then fixed by moulding the plaster against it. It is now nearly five years since this operation was performed, and except for a preliminary two months after the removal of the plaster, during which time he received massage and remedial exercises, the patient has been working steadily at his trade. I saw him in May of last year, and he has no disability whatever and the patella is in normal position. The new ligament can be seen and felt passing from the patella to the internal condyle.

We have used segments of the tendo Achillis as transplants in a variety of conditions and in no case has any disability of the leg resulted. After the removal of the transplant the sheath is carefully closed, and when two months have gone by the tendon appears to be as strong as ever.

This type of operation has been performed also by Dr. Starr in a case of recurring dislocation of the patella in a young girl. He used a strip of fascia lata as the new ligament, and the result was equally satisfactory. Fascia lata is the ideal tissue for transplantation, unless the anticipated strain is very great, as in laboring men.

About eighteen months ago a man came to us with a rupture of the ligamentum patellae produced by a severe fall against a radiator. He had been splinted for several months but without union of the liga-

ment. We saw him a year after the accident, walking like a man with an artificial leg, with no power to extend the knee. In this case we made a new ligamentum patellae from two thick strands of his tendo Achillis. These were passed through holes bored longitudinally through the patella, and carried down to the tubercle of the tibia, where they were again passed through holes in the bone. The patella was drawn down to near its normal position and the new ligaments stitched to the periosteum of the patella and tibia with catgut to hold them in correct position till healing could occur. This patient made an excellent recovery and is now engaged in his regular occupation as a bricklayer. Since then, another similar case has been operated upon with an equally satisfactory result.

The success of this operation led us to try a similar plan with a case of non-union of the patella in which the lower fragment was so small that we had little hope of satisfactory bony union. The fragments were freshened and drawn together in the usual way with kangaroo tendon, and the ruptured periosteum closed with catgut. A heavy strip of fascia lata was passed from above downward through holes in the two fragments, then transversely through the ligamentum patellae, and back through similar holes in the fragments, and stitched together at the upper border of the patella. The result in this case was perfect and the patient has complete use of the limb. We were so impressed with the appearance of this case at the time of the operation that we have decided to use the principle in all cases of non-union of the patella, whether we can get the fragments together or not. Even when the freshened surfaces of the bone can be brought together the result is always in doubt, and it seems to us preferable to make certain of a good functional result by this means, rather than to run the risk of a complete failure of the operation. We would recommend, however, that tendo Achillis be used instead of fascia lata in heavy or powerful persons.

The principle as applied to making new ligaments has been used in various other ways. On several occasions we have done arthrodeses of the mid-tarsal joints in small children and fastened the bones together with strips of tendon with the idea of securing a functional result should the arthrodesis fail. Similarly, in doing astragalectomy for calcaneo-valgus, we fasten the external malleolus forward by fixing a strip of the peroneus brevis into the external malleolus. One of the causes of failure in this excellent operation is that after the patient begins to walk the locking of the navicular bone against the lower end of the

tibia produces so great a leverage that frequently the external malleolus gradually slides backwards and the patient ends up with a calcaneo-varus deformity. This can be prevented by the simple precaution of making a strong new ligament which will prevent the posterior displacement of the malleolus.

In the preliminary portion of this paper we have already outlined the principles which we believe should govern the technique of uniting one tendon to another. Many a tendon inplantation has failed owing to pulling apart of the two tendons or stretching of the connective tissue which forms between them. Some have overcome this difficulty by using silk or linen sutures, but in our experience this expedient is not satisfactory, as in a certain percentage of cases the sutures will set up sufficient irritation to produce sinuses weeks or months after the operation, which will persist until the foreign material is discharged or removed. This difficulty can be avoided by dispensing with the non-absorbable sutures, and by weaving the tendons into one another with raw surface to raw surface, and fixing with fine catgut. If this is done thoroughly the healing will be sufficiently firm at the end of three weeks to allow gentle movement.

When gaps in tendons are to be bridged, transplants of tendon or fascia make ideal material for the operation. When used in the ordinary way, however, that is, by end-to-end suture, or overlapping suture of strips or tubes of fascia or of pieces of tendon, the result is very uncertain as the line of suture is apt to open up. We got over this difficulty at first by splicing the transplant into the ends of the tendon, and the method proved quite successful, but since the idea occurred to us of threading the transplant on a needle the operation has been much simplified and improved. The narrow strip of fascia is now woven backwards and forwards across the gap and into the ends of the tendon with whatever tension the retraction of the muscle appears to require, and is finally anchored by a catgut ligature. Active movements may be begun early without anxiety as to the healing of the suture and without fear that the ends of the tendon will ultimately stretch apart.

Living sutures of fascia and tendon are useful in other ways. About a year ago we applied the method to a case of infantile paralysis involving the shoulder and arm. The deltoid, supra- and infraspinatus, biceps, brachialis anticus, and triceps were completely paralyzed, and the pectorals and latissimus dorsi had only a little power. The shoulder-joint could be dislocated at will. The forearm and hand, however, were perfect, and the presence of a strong trapezius made us hopeful

that the child's condition might be improved by a muscle transplantation. In this case we placed the arm in a position of 45° abduction and fastened the acromion to the greater tuberosity of the humerus by strips of fascia lata passed backward and forward through each. The central portion of the trapezius was then raised from the acromion along with the periosteum into which it was inserted, and sutures of fascia lata woven into it. These sutures were carried over the head of the humerus and fastened into holes bored in the bone at the insertion of the deltoid. The patient is now able to abduct the arm to nearly 45° and by so doing can carry the hand to the mouth by contracting the muscles of the forearm. A reconsideration of this case has convinced us that the transplantation of the central portion of the trapezius muscle was an unnecessary step in the operation. While the patient is able to abduct the arm from the side to practically the angle at which it was placed during the operation, she does so by rotating the scapula. It seemed to us likely that a similar result could be obtained by the very simple operation of suturing the acromion to the greater tuberosity of the humerus with stout strips of fascia lata. Recently we had an opportunity to test the soundness of our conclusion in another patient suffering from a similar paralysis. In this case the shoulder was fastened at an angle of 60° with the body, as this angle is preferable, and the resulting improvement has been remarkable. This patient is able to abduct the arm freely and even get his hand to the top of his head, and owing to the presence of slight power in the pectoralis major and latissimus dorsi, he has practically a normal range of antero-posterior motion.

The principle of living sutures has proved of value in other conditions which must be considered as belonging to general surgery. The chief of these is hernia, particularly direct inguinal hernia, and large ventral hernia. We have had an excellent opportunity to test its value among soldiers who have returned to hospital because of the failure of previous operations. In our series of fifty cases there has not been a single recurrence over a period of three years. This amply proves the strength and durability of the suture and the value of the method of inserting it.

This short review of our cases will serve to indicate the many fields in which the transplantation of fascia and tendon may be of value. That it has never become popular in the past is due, we believe, to failure to observe the principles which govern the process of repair, and

with these principles fully understood it is a simple matter to ensure a high percentage of successes. There appears to be no good reason now for ever employing silk for ligaments, tendons or buried sutures, nor is it necessary to take the risk of failure by trusting to the uncertain healing of fibrous structures which have been simply fastened together with catgut or other absorbable material. It is obviously more rational to use as ligaments, tendons, or sutures, material which we know will live and retain its normal characteristics. Before reporting the results of our experiments and clinical investigations we have given the methods described most careful study in the laboratory, and have allowed the lapse of time to test the permanence of the clinical results, so that we feel that we can safely recommend them for general surgical use.

REFERENCES.

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[2] Annals of Surgery, March, 1913; Jour. Am. Orth Assn., January, 1916.

News Notes

Dr. W. Eugene Wolcott, of Omaha, has sailed for Europe, to spend the summer studying in the clinic of Sir Robert Jones, and to observe orthopaedic work being done in various centers of Austria, Belgium, France, and Italy.

The combined meeting of the Interurban Orthopaedic Club and the Eastern States Orthopaedic Club was held in New York on March 31st and April 1st. Dr. Clarence L. Starr, as Honorary President of both clubs, presided at the executive sessions and acted as toastmaster at the dinner held at the New York Athletic Club.

Of special interest were Dr. Clark's and Dr. Bancroft's most suggestive observations on repair of bone, indicating how very far we are yet from complete understanding of bony processes and the exact functions of the various cells having to do with bone growth and destruction.

Following the luncheon on Saturday, a most interesting discussion on the subject of pay clinics was opened by Dr. Wilson of Cornell Medical School. Their success with the pay clinic seems assured.

Dr. Van Buren, representing Dean Darrach of the College of Physicians and Surgeons, outlined in a most interesting way the plans for the new and large development of the Medical School by Columbia University.

The Graduate Department of Hygiene and Physical Education of Wellesley College makes the following announcement in its Bulletin for the coming year:

"A strictly limited number of graduate scholarships are open to students in the Department of Hygiene and Physical Education. These are open to students only in their second year and are awarded for unusual promise in research or teaching power.

"Research fellowship of one thousand dollars for the study of Orthopedics in Relation to Hygiene and Physical Education.

"General requirements to be met by the successful applicant: good health; the Bachelor's degree from a college or university of good standing; sound preparation in chemistry, physics, and biology; special preparation in anatomy, kinesiology, and physiology; familiarity with the elements of orthopedic theory and practice; and an insight into some one or more of the problems of orthopedics as related to hygiene and physical education.

"The work on the problem chosen in consultation with the department must be done in residence at Wellesley College except for study and observation of

clinical practice. It will, in general, begin in September following the acceptance of the applicant and will continue through one calendar year. It will involve kinesiology, applied physiology, and the study of clinical material. For the latter, opportunity will be provided to study the work of orthopedic surgeons in Boston and other eastern cities. The results of the investigation are to be embodied in a thesis to be submitted to the department and published.

"Those wishing to apply for this fellowship should send their evidence of preparation and qualifications to the Director, Graduate Department of Hygiene and Physical Education, Wellesley College, Wellesley, Mass. The decision reached by the department will be based upon the applicant's record, upon personal correspondence, and when possible, upon personal interviews."

The Robert Jones Orthopaedic Society held its Spring meeting in Boston on April 21st and 22nd, under the honorary presidency of Dr. Robert B. Osgood. The Society is composed of men practising orthopaedic surgery in the cities along the eastern coast of the United States and Canada. Two new members were elected, Dr. Alan DeForest Smith, of New York, and Dr. W. A. Cochrane of Boston.

The morning of the first day of the meeting was spent at the Orthopaedic Ward of the Massachusetts General Hospital, with the following programme: Ward Visit, Dr. R. B. Osgood; "Congenital Dislocation of Hip," Dr. Z. B. Adams; "Treatment of Hand Injuries," Dr. W. A. Cochrane; "Scoliosis," Dr. Armin Klein; "Tennis Elbow," Dr. R. B. Osgood; "Separation of the Upper Femoral Epiphysis," Dr. Albert Key; "Sacro-Iliac Arthrodesis," Dr. M. N. Smith-Petersen; "Low Back Pain," Dr. P. D. Wilson; Out-Patient and Ward Visit with the Fracture Service, Dr. D. F. Jones.

In the afternoon the programme was as follows: "Arthritis," Dr. L. T. Swaim, Robert B. Brigham Hospital; "Reconstruction Surgery," Dr. Frederick Cotton, Boston City Hospital.

On Saturday morning the Society visited the Children's Hospital, with the following programme: Ward Visit, Dr. R. W. Lovett; "Birth Injuries of the Central Nervous System," Dr. Bronson Carothers; "Poliomyelitis," Dr. A. T. Legg; "Obstetrical Paralysis," Dr. J. W. Sever; "Operation for Club-Foot," "Incision for Drainage of Hip," Dr. F. R. Ober.

The American Orthopedic Association held its annual meeting in Washington on May 1st to 3rd, with Dr. Nathaniel Allison of St. Louis as presiding officer.

Dr. Murk Jansen of Leiden was the guest of the Association and added greatly to the value of the meeting by his scholarly and philosophical discussion of the subjects presented.

At the annual dinner, Senator Spencer of Missouri, General McCaw and the Reverend Mr. Freeman of Washington were the speakers.

Dr. R. R. Fitch, of Rochester, N. Y., is the President of the Association for the coming year.

Plans have been made and approved by the Ancient Order of the Mystic Shrine for five hospitals for crippled children in the cities of St. Louis, San Francisco, Shrevesport, Montreal, and the Twin Cities of St. Paul and Minneapolis.

In St. Louis, Dr. Nathaniel Allison has been appointed Chief of Staff, and a temporary contract made with Washington University, breakable by either party in six months, for the Hospital to be staffed by Dr. Allison and the Faculty of the University.

In San Francisco the Chief Surgeon will be Dr. Walter I. Baldwin; in Shrevesport, Dr. Guy A. Caldwell; in the Twin Cities, Dr. Wallace H. Cole; and in Montreal, Dr. A. Mackenzie Forbes.

In view of their appointment as Chief Surgeons, Dr. Allison and Dr. Forbes have resigned from the Advisory Board of the Shriners' Hospitals for Crippled Children, and Dr. W. E. Gallie, of Toronto, and Dr. Edwin W. Ryerson, of Chicago, have been appointed in their stead.

The summer meeting of the British Orthopaedic Association was held at Alton on Friday and Saturday, May 26th and 27th, 1922.

On the first day of the meeting a visit was made to Sir William Treloar's Hospital for Crippled Children, where a demonstration of cases was given.

Of interest to orthopaedic surgeons travelling abroad this summer is the announcement from Dr. Calot of a course to be given at Berck-Plage from the 7th to the 13th of August. Detailed information regarding the course may be obtained from Dr. Fouchet, Institut Calot, Berck-Plage (Pas de Calais), France, or from Dr. Colleu, Clinique Calot, 69 Quai d'Orsay, Paris. The course, which is intended both for physicians and students, will be given in English and Spanish, as well as in French, and will include instruction in the subjects indispensable to the practice of orthopaedic surgery, with actual demonstrations of treatment.

Current Orthopaedic Literature

TUBERCULOSIS.

EARLY DIAGNOSIS AND TREATMENT OF JOINT TUBERCULOSIS. J. T. O'Ferrall. *Southern Medical Journal*, February, 1922.

The point is made in this paper that the average practitioner does not use sufficient care in making a diagnosis of tubercular joint disease, and that there is not enough uniformity of opinion as to the best treatment for this condition. Rest, general hygienic surroundings, freedom from weight-bearing, and heliotherapy are urged.—*Edward S. Hatch, New Orleans.*

TUBERCULOSIS OF THE UPPER EXTREMITY: RESEARCH STATISTICS ON 86 CASES OF ISTITUTO RIZZOLI (PROF. PUTTI). Giovanni Valtancoli. *Chir. degli Org. di Mov.*, Vol. 5, No. 6, December, 1921.

In comparison with the lower extremity, the number of cases of tuberculosis of the upper is rather small. The author's statistics contain 86 cases, divided as follows: 17 cases of tuberculosis of the shoulder joint and scapula; 41 cases of tuberculosis of the elbow, and 28 cases of tuberculosis of the wrist.

1. Tuberculosis of the shoulder. 17 cases, or 19.7 per cent. of tuberculosis of all joints of the upper extremities. It is decidedly rare in the first decade, only one case of that age being recorded. It is much more frequent in the second decade, which figures with 8 cases in this series.

Tuberculous heredity was found in 23.5 per cent. Other localizations, either pulmonary or bony, were recorded in 41.2 per cent. of the cases. Trauma was not found to be of etiological importance, being recorded in only 2 cases. Symptoms: The symptoms vary somewhat, according to whether one is dealing with the dry form (caries sicca) or with fungus form with formation of abscesses.

In the first group, there is always considerable atrophy of the shoulder region, the atrophy involving principally the deltoid and other neighboring muscles of the scapular girdle. The pain is intense, sometimes occurring spontaneously, but more often provoked by movement of the shoulder. The active motion of the shoulder is very much limited, and a peculiar grating is noted.

In the fungus form, the formation of abscesses, swelling of the joint, the production of fistula, and the very considerable atrophy of the arm are principal symptoms.

Of these cases, 23½ per cent. belonged to the dry form, and 76 per cent. to the fungus form of shoulder tuberculosis. The seat of the disease was more often in the humerus: only in one case was the lesion situated in the scapula

alone. Results: Of 17 cases, 8 were treated surgically. Of these 8, 7 were resected totally, and one partially. Nine cases were treated by immobilization in removable plaster cast and by heliotherapy.

The immediate result of the cases operated upon was good. Only one case returned after 6 years on account of the recurrence of pain in the articulation.

In all cases treated conservatively, all showed a regression of the morbid process, although there was more or less functional impairment, due to the limitation or total abolition of motion.

2. Tuberculosis of the elbow: 41 cases, or 47.7 per cent. All cases were unilateral. In regard to the age, the greatest number involved the 3rd quinquennium. Heredity was found in 7 cases, or 17 per cent. Other tuberculous manifestations were found in 18, or 43.9 per cent.

Trauma as etiological factor was established in 9 cases, or 21.9 per cent. Symptoms: The symptoms were essentially those generally found in chronic tuberculous arthritis: tumor, limitation of motion, fixation in semiflexion, tenderness, which was very slight on rest and very decided on motion, and, finally, very considerable muscular atrophy. There was a considerable tendency to formation of sinuses.

Pathology: In the 9 cases which were resected the ulna was most frequently involved, especially the sigmoid cavity. Only in 1 case was there an isolated lesion of the olecranon. The humerus was involved in 4 cases and the radius in 2. Ten cases, or 25 per cent., showed 1 or more sinuses.

Results: Cases treated surgically, 11; of these, 8 were totally resected, 1 was partially resected, 1 was treated by arthrotomy, 1 by amputation. Cases treated by immobilization in plaster-of-Paris cast together with heliotherapy, 30.

On the whole, the result of the treatment was satisfactory. In the cases resected, a solid ankylosis was obtained. None of the cases operated upon returned to the Institute on account of recurrence of symptoms.

Especially good functional results were obtained by partial resection of the olecranon in cases of extra-articular focus. The cases treated conservatively required on an average 2 years for their cure. Of 10 cases in which late results were obtainable, 7 had ankylosis, while in 3 a partial movement of the elbow remained. None of the cases died.

3. Tuberculosis of the wrist: 28 cases, or 32.5 per cent. Two of the cases were bilateral. Tuberculosis of the wrist is by far most frequent in the young, especially in the first infancy. The greater number of cases was found in the first decade (9 cases). Next came the second decade with 7 cases.

In only 2 cases tuberculous heredity was established. In 12 cases, or 42.8 per cent., there co-existed tuberculous affections of other joints or glands or viscera.

Trauma was established in 6 cases, or 21.4 per cent. Symptomatology: The most prominent symptoms were gradual onset, slow course, progressive tumor formation, pain, and tenderness on motion, rapid increase of functional impairment, fusiform swelling of the wrist, with tendency to flexion. Sinus formation was frequent, being found in 6 cases, or 21.4 per cent.

Pathology: Four cases showed almost complete destruction of the bones of

the wrist and 2 of these also caries of the radial and ulnar epiphyses. In 1 case the involvement of the radius produced a tendovaginitis with rice bodies in the sheath of the long extensor of the thumb. In 1 case, there was an isolated lesion of the os magnum.

Results: In only 6 cases a surgical operation was performed, consisting in conservative resection of the articulation. The other 22 cases were treated conservatively with bivalve plaster casts, immobilized in slight dorsiflexion in a manner which permitted free play of the metacarpophalangeal articulations.

One case only ended in death, but this was due to a co-existing hip disease.

In the other cases, the outcome was cure, although the majority of cases showed almost complete loss of motion in the wrist-joint. Of 6 cases which were seen several years later, in 2 the mobility of the wrist was preserved in a moderate degree, while in 4 the joint was completely stiff.—*A. Steindler, Iowa City, Ia.*

TRAUMATA.

DIAGNOSIS OF FALSE FRACTURES OF THE FEMORAL NECK (RACHITIC COXA VARA). Bloch. *La Presse Médicale*, January 7, 1922, p. 26.

A condition is frequently observed (in children) simulating fracture of the neck of the femur, but which is in reality a traumatic coxa vara. The line which looks like a fracture is the conjugal cartilage, rendered more or less transparent by rachitis. The lesion may occur (1) near the trochanter with a bend in the neck near its base, the conjugal cartilage being wide and sometimes horizontal; (2) in the middle of the neck, where the cartilage is vertical and often bifurcated; (3) near the head, simulating an epiphyseal separation.

It may develop without trauma. This is proved by a series of roentgenograms of the hip of a child which show the lesion occurring in the middle of the neck after the patient had been in bed constantly for eighteen months.

It differs from pathologic fracture in that there is no over-riding of the fragments.—*William Arthur Clark, Pasadena, Calif.*

TREATMENT OF FRACTURE OF THE CLAVICLE BY CONTINUOUS TRACTION. Burian. *La Presse Médicale*, January 7, 1922.

A figure-of-eight bandage is put around the shoulders, crossing in the back and pulling the shoulders backward. The continuous traction is obtained by means of a strong rubber tube passing around this bandage in the middle of the back and anchored to the back part of a belt around the waist. To keep the belt down, perineal straps are added. It will be noted that there is no splint applied behind the shoulders.

In applying the apparatus two assistants are necessary. One stands in front, abducts the patient's arms and pushes them backward. The other stands behind, furnishing support with one hand on the patient's back, the patient being seated. There are no dressings over the fractured clavicle and the position of the fragments can be verified at any time.—*William Arthur Clark, Pasadena, Calif.*

A Bone Plate for Use in Fractures Close to Joints or to Epiphyses. W. H. Byford. *Jour. A.M.A.*, Feb. 11, 1922.

A short bone plate of non-corrosive material is described, 1 inch long, ¼ inch broad, and 1/32 inch thick. At each end are three fixed pins ⅜ inch long, with cutting ends. When the fracture has been exposed the plate is to be hammered on. Little force and but a small incision are necessary. The surrounding bones receive little trauma as no drill holes are needed, and the plate may be used on small bones.

A case is cited where fracture of both radius and ulna close to the wrist joint was successfully treated by the plate.—*J. A. Nutter, Montreal.*

Bilateral Subacromial Luxation of the Humerus by Muscular Action in Epilepsy. Costantini. *La Presse Médicale*, January 18, 1922, p. 48.

Malgaigne gave the name subacromial to "a luxation in which the humeral head is found under the posterior angle of the acromion." It is a rather rare lesion; only 34 cases being collected by Malgaigne.

The author reports a case as follows:

A man of 48, after an epileptic convulsion, noticed great difficulty in moving his shoulders. Examination showed no flattening of the shoulder. On the contrary, the upper end of each arm seemed to be somewhat displaced from the body. The elbows were forward and the upper arm rotated inward. The patient could get a spoon up to his mouth only by bending the head down, and with great difficulty and pain. Passive motion in the shoulder limited to slight abduction, internal rotation, and backward motion (hyperextension); all these movements very painful. It was impossible to bring the arm forward (flexion), to adduct it, or to rotate it outward. Roentgenograms showed posterior displacement of the humeral heads and abduction.

The luxations were reduced under general anesthetic by downward traction and rotation both ways until the head snapped back into place. After about a week, motion in the shoulders was normal.

Many of these cases occur during epileptic attacks, 8 of the 34 collected by Malgaigne.

The deformity at the shoulder following such a luxation is very slight. There is no flattening such as is seen in forward dislocations, except a very slight amount anterior which is difficult to recognize except by comparison, which, of course, is impossible in bilateral lesions.

The functional disturbance, on the contrary, is quite marked. External rotation is the most difficult movement because the mechanism which produces the luxation is a strong spasm of the internal rotators of the humerus, pectoralis major, subscapularis, and anterior part of deltoid. This may explain the frequency of bilateral occurrence in epilepsy, the strong muscle spasm acting with the same force on both sides at once. Non-epileptic cases of luxation of

the humerus by muscular force are rarely bilateral; only one in 23 cases collected by de Hintz.

Malgaigne in experiments on the cadaver was able to produce a subacromial luxation by forced inward rotation. The author, in repeating these experiments, found that it was necessary to add a forward projection of the elbow (flexion of shoulder) to the inward rotation in order to produce this luxation. This flexion of the shoulder brings the groove of the anatomic neck of the humerus parallel with the posterior lip of the glenoid so that the head slips off and the groove locks over the lip. If the arm is along the side of the trunk (complete extension), the groove lies at an angle with the lip and consequently does not lock over it. In dissecting the shoulder joint after forced internal rotation with the arm along the side, the author has found the capsule torn posteriorly but the head in normal position.—*William Arthur Clark, Pasadena, Calif.*

MECHANISM OF FRACTURES. FRACTURES FROM SHEARING FORCES. C. Ghillini. *Chir. Org. Mov.*, Vol. 6, No. 1.

From the viewpoint of the mechanism, fractures are commonly divided into direct and indirect fractures from causes of compression, bending, torsion, or avulsion.

When the forces act parallel to the axis of the bone in divergent direction, the resulting fracture is a tension fracture, while with two forces acting parallel with the axis and convergent, the resulting fracture is a compression fracture.

With the acting forces perpendicular to the axis, the fracture occurs in flexion.

With the acting forces perpendicular to the axis and in a circular direction upon a given point, torsion fractures occur. Finally, with the acting forces perpendicular to the axis passing in their plane through the bone, the so-called shearing-force fractures occur.

One of the most common fractures of this kind is that of the lower epiphysis of the radius. Another of this kind is a fracture of the lower end of the humerus. The author cites an example of each of these two kinds, giving radiographs of the fractures.

He presents the x-rays of the two above-named fractures, together with the dynamic explanation of their occurrence, mainly for the purpose of showing that these fractures are shearing fractures and not, as commonly considered, avulsion fractures.—*A. Steindler, Iowa City, Ia.*

FRACTURE AND DISLOCATION OF CERVICAL VERTEBRAE WITHOUT PARALYSIS. W. E. Hartshorn. *Boston Med. and Surg. Jour.*, Feb. 2, 1922.

Report of a case of fracture and forward dislocation of second and third cervical vertebrae with no paralysis at any time, though the displacement was considerable. No effort was made to reduce it. The patient was treated by rest in bed with moderate head traction, followed by back brace with head support. Recovery with only marked stiffness of the neck.—*R. W. Billington, Nashville.*

MANAGEMENT OF FRACTURES NEAR JOINTS. P. H. Kreuscher. *Ill. Med. Jour.*, Feb., 1922.

Dr. Kreuscher recommends the use of the fluoroscope in reducing fractures, and suggests a special apparatus for traction in conjunction with the x-ray outfit. The increased difficulty of caring for fractures near joints is due, first, to the trouble one experiences in approximating the fractured ends; second, to the inability to retain them in place once they have been approximated, and, third, to the complication following bleeding into the joint. Additional factors in severe cases are open fractures with infection. In infected joints he advocates aspiration of the infectious contents and the injection of 2% formalin in glycerin—the Murphy formula—with the addition of 2% apothesine to control pain. In children epiphyseal injuries may lead to later deformities. He gives special consideration to fractures in or near the elbow, hip, knee, ankle, and the temporomaxillary articulation. In fracture of the mandible near the joint he favors the use of the Murphy wedge placed between the maxillae on either side, giving to the jaw the same effect as Buck's extension on the limb in keeping the joint from ankylosing.

Regarding the shoulder joint he believes 95% of the fractures in this position should be reduced by operation, rather a startling statement in the face of so many excellent results obtained by reduction and retention in the right angle abduction position. He prefers deferring operation until ten days have passed to reduce the hemorrhage and the likelihood of infection. The Murphy-Lane operative technic is used, and the Lane plate or wire staples are the mechanical devices used to retain apposition, frequently without the customary external fixing measures, merely placing the arm in a sling with the elbow elevated and the hand flat against the chest in supination.

In elbow fractures, usually involving the internal condyle, if replacement cannot be secured with the aid of the fluoroscope, it should be obtained by operation and held in place with a screw, nail, or peg.

He warns against too early manipulation of the joint as an exciting cause of increased callus formation with consequent limitation of movement. He believes Colles' fracture is usually well managed, a very optimistic view, to say the least. In fracture of the neck of the femur, he states that "a number of surgeons have reported good results from the use of the extreme abduction methods of Whitman." Kreuscher uses the Murphy method, in which the patient, except where there is an impaction, "is placed into a Travois abduction splint with a Buck's extension on the affected limb of from 10-15 pounds."

Further he states, "In a large percentage of the cases, the interposition of joint capsule takes place and prevents a bony union. Inasmuch as this is such an important weight-bearing joint and with our present day methods of bone operations, we are justified in all instances in which the patient's physical condition warrants in doing an open operation through an incision, which gives you direct access to the neck of the femur." A long screw or nail driven through the great trochanter is used for fixation.

In Pott's fracture of the ankle, where reduction is easy, he advises holding the foot in marked inversion from two and a half to three weeks, when the result will be a good one. In the older cases operation is necessary, with retention of the corrected malleolus with a nail or other fixing apparatus.—*Charles A. Parker, Chicago.*

Sacro Iliac Sprain. E. D. Martin. *Southern Med. Journal*, Feb., 1922.

The author read this paper before the Southern Association of Railway Surgeons. Nothing new is brought out; simply a plea to bear the diagnosis in mind in treating pain in the back and legs. Three cases reported.—*Edward S. Hatch, New Orleans.*

Dislocations and Fracture-Dislocations Occurring at the Acromio-Clavicular Articulation. R. W. McNealy. *Ill. Med. Jour.*, March, 1922.

In the complete intractable dislocation of this joint McNealy favors an open operation, beveling the clavicle in the opposite direction from the normal shape and tightly approximating the acromion with two piano wire sutures. Fixation is maintained by a Velpeau bandage covered with a plaster bandage for a period of six weeks, when, if conditions are favorable, the wires are removed under local anaesthesia, and light exercises instituted.—*Charles A. Parker, Chicago.*

A Mechanical Device to Facilitate the Handling of Patients in the Whitman Abduction Splints. O. F. Schussler. *Minnesota Medicine*, Feb., 1922.

The author describes a block and tackle method for handling patients who are being treated for fractures of the hip by the Whitman method. A canvas strip six inches wide and sixty inches long, having an iron ring at either end, is placed under the patient at the level of the iliac crests.

Photographs show how the patient may then be lifted and turned by the aid of a double set of blocks suspended from an overhead frame. Such a method helps in the care of the patient, in changing of bedding, and in the securing of rest, which a change in position brings.—*H. T. Jones, Rochester, Minn.*

Two Unusual Cases of Injury to the Tibial Tubercle. James Warren Sever. *Boston Med. and Surg. Jour.*, March 9, 1922.

Osgood and Schlatter, in separate articles, in 1903 called attention to injuries of the tibial tubercle and its epiphyseal cartilage. This condition is still fre-

quently overlooked or confused with other troubles, such as house-maid's knee, pretibial bursitis, etc. The x-ray findings often prove misleading and should always be compared with those of the healthy limb. Operation on the tubercle for fixation of its epiphyseal beak to crest of tibia is rarely necessary and he thinks bone-grafting and pegging for this condition are meddlesome.

The first case reported was that of a boy, age 16, with complete separation of the tubercle due to muscular action while jumping. Open reduction and suture with kangaroo tendon gave a perfect result in three months.

The second case was that of a man, age 22, with chronic disability since an injury to the knee at seven years of age. X-rays showed separation of part of epiphysis, apparently adherent to under side of patellar tendon. There was crepitus at this point on knee motion. This fragment was removed by operation, with complete recovery.—*R. W. Billington, Nashville.*

TREATMENT OF FRACTURES OF THE METACARPALS AND PHALANGES OF THE FINGERS. R. D. Wheeler. *Jour. A.M.A.*, Feb. 11, 1922.

A method of obtaining extension in the case of metacarpal and phalangeal fractures is described and illustrated. A plaster-of-Paris cast is applied to the forearm, incorporated in which is a wire loop projecting two or three inches beyond the fingers. Loops of gauze bandage are attached to the finger ends by a glue composed of celluloid dissolved in acetone, and these loops are attached by rubber tubing to the wire. In this way the overriding and angulation so often seen in metacarpal fractures and those of the proximal phalanges are overcome. Free access to wounds is permitted, and the celluloid is impervious to water.—*J. A. Nutter, Montreal.*

ARTHRITIS.

ARTHRITIS DEFORMANS AS A DEFICIENCY DISEASE. G. C. Belcher. *British Medical Journal*, February 4, 1922, p. 186.

While multiple arthritis frequently associated with some deformity in children can, like acute rheumatism, usually be said to be related to blood infection, the chronic arthritis occurring chiefly in adult or middle aged women, less often in young adolescents and men in middle life, does not to the mind of the author come under the category of an infection. Comparing these cases with diseases connected with improper feeding impressed the writer that these conditions were associated with deficiency diseases. Arthritis deformans is frequent in women of the poorer classes who rarely have properly selected food; then these women are deprived of the essential salts necessary to health existence, and the mineral salts contained in the bone are taken up into the poorly nourished blood and tissues with low mineral content, leaving the bone in the eroded condition so well known in the last stages of the disease. One of the chief reasons for the association of the arthritis with deficiency disease is that its occurrence is most often in the class of patients who have been for years living upon an improperly selected diet.

The author notes also that in one district where the water was hard, with a large amount of both temporary and permanent salts, that the occurrence of osteo-arthritis was infrequent. In another district, where the water was soft with little or no temporary or permanent hardness, cases of osteo-arthritis were much more numerous.—*L. C. Abbott, Ann Arbor, Mich.*

THE TREATMENT OF CHRONIC ARTHRITIS, WITH SPECIAL REFERENCE TO END RESULTS. Walter L. Bierring. *Illinois Medical Journal*, June, 1921.

All cases of arthritis should be regarded as chronic where the symptoms have extended beyond one year.

The treatment consists of: 1, removal of infective foci; 2, local therapy to the affected parts; and 3, general care of the patient.

Practically all cases of chronic arthritis are due to some infective agent. The most frequent sites of focal infection are the teeth, tonsils, genito-urinary tract, sinuses, bronchi, gall-bladder, gastro-intestinal tract, pancreas and the appendix.

The question of what constitutes pathology in the tonsils is a matter on which there is room for considerable discussion. Dental foci, although clearly demonstrable by the radiologist, are open to false interpretation. For clinical purposes arthritis may be classed with diabetes and gout, in that there is in each case a limit of tolerance for carbohydrates on the one hand and proteids on the other. Special dietary regulations as a means of therapy in selected cases of chronic arthritis are advisable, especially where a demonstrable focus of infection or definite causative agent is not present.

There is no measure that affords so much relief and comfort as baking the affected joints, usually carried out daily with one free day each week. It relieves pain and has a good effect on the swelling and stiffness. When the acute symptoms have subsided systematic massage should be given by an experienced masseur. Medicines occupy but a minor place. Vaccines and the injection of foreign protein are still in an experimental stage.

While the removal of the infective foci should be of first importance, the general care of the patient should have an equal place in any plan of treatment, and this can only be properly carried out in a hospital where every facility for examination is available and all possible forms of therapy may be used.

The problems involved in diagnosis and treatment bring these cases properly within the sphere of internal medicine, the advice and co-operation of the orthopedic surgeon being a necessary factor in the successful treatment.—*Walter G. Elmer, Philadelphia.*

CHRONIC ARTHRITIS. Leonard W. Ely. *Medical Record*, February 11, 1922.

Ely divides all chronic arthritides into two classes which he designates simply as Type I and Type II. This division he makes on the basis of the pathological anatomy and roentgen appearances of the bones. Moreover, it happens that all those cases which belong in Type I have a known etiology, while the cause of Type II is unknown. Beside this, the clinical behavior of the two groups is quite different.

Type I includes the condition known by various writers as proliferative arthritis, atrophic arthritis, rheumatoid arthritis, etc. The causative agent is

one of the known infections—tuberculosis, syphilis, typhoid, pneumococcus, diplostreptococcus, etc. The lesion is a proliferative inflammation in the synovial membrane, bone marrow or both, resulting in recovery or in fibrous or bony ankylosis. The x-ray shows rarefaction of the bone, thinning of the cartilage, but no new production of bone. Clinically Group I causes pain, local sensitiveness, and limitation of motion, and usually local temperature, swelling of soft parts, muscle spasm, and atrophy, but no new production of bone outside the normal level. The joint may or may not contain fluid. This form may be mono- or multi-articular. The x-ray shows a rarefaction of bone next the joint, irregularity of joint outline and approximation of the bones forming the joint because of thinning or destruction of the cartilage. Treatment of this group includes the removal of the cause in tubercular cases, depriving the joint of its function either temporarily or permanently.

Type II is a multiple, progressive form of arthritis whose cause is unknown. All attempts at demonstrating a bacterial origin of this type have been unsuccessful, yet the appearance of specimens indicates an infection of some sort as the cause. The author inclines to the belief that the offending organism is a protozoon, probably the amoeba histolytica, gaining access to the circulation most frequently through diseased alveolar processes at the roots of decayed teeth. The primary lesion in this type is a necrosis in the bone marrow in the immediate vicinity of the joint, whose cause is unknown. New bone is then laid down about the necrotic areas, especially beneath and at the periphery of the joint cartilage. The cartilage becomes calcified and wears away, leaving eburnated bone, while lipping occurs around the edges of the joint distorting the ends of the bone. The synovial membrane becomes thickened and villous, causing creaking and grating on motion. The subjective symptoms are less marked than in Type I, but in the spine this type may cause interlocking or even bony union.

The differential diagnosis between the two types is best made by the x-ray examination, which shows new bone formation in Type II.

The principal indication in the treatment of Type II is the removal of foci of infection from about the roots of teeth. The new bone formation is permanent.—*C. L. Lowman, Los Angeles.*

THE AMOEBA AS THE CAUSE OF THE SECOND GREAT TYPE OF CHRONIC ARTHRITIS. PRELIMINARY NOTE. By Leonard W. Ely, Alfred C. Reed and Harry A. Wyckoff. *California State Journal of Medicine*, February, 1922.

The "Second Great Type" is the name applied by the authors to the condition known as arthritis deformans, osteo-arthritis, hypertrophic arthritis, etc.

Ely has previously shown that the primary change is a necrosis in the bone marrow in the neighborhood of the joint, of hitherto unknown cause. Dr. John V. Barrow of Los Angeles suggested a relationship between amoebae and this necrosis, after having found the amoeba histolytica in the stools of one of Ely's patients. Following this suggestion endamoeba histolytica were found by the authors in sections of bone from the region of the necrotic areas. These were abundant in the region of the necrotic area but not actually in the necrotic areas.—*C. L. Lowman, Los Angeles.*

INFECTIOUS ARTHRITIS OF THE SPINE. Sigmund Epstein. *Amer. Jour. Med. Sciences*, March, 1922.

Arthritis of the lumbar spine, traceable to infections, is a common cause of low back pain. Staphylococci, streptococci, Eberth's paratyphoid bacilli, are the usual causative organisms. (Gonorrheal, syphilitic, and tabetic spines not included.)

Inflammatory exudate, adhesions, absorption of cartilages, destruction of bony tissue, deposits, excrescences, and ankylosis take place. Deviation of the spine and moderate kyphosis may occur. Acute cases are often mistaken for Pott's disease or sciatic scoliosis. Under treatment the deformity may be overcome and recovery take place with but little impairment of function. Treatment is essentially mechanical: plaster jacket and rest in bed during the acute stage, braces to control deformity and prevent relapses, removal of definite foci of infection. Six interesting cases are reported with three illustrations.—*F. G. Hodgson, Atlanta, Ga.*

RHEUMATOID ARTHRITIS DUE TO INFECTION OF THE NASAL ACCESSORY SINUSES. By P. Watson-Williams. *British Medical Journal*, January 21, 1922, p. 88.

The author believes that while the teeth, tonsils, genito-urinary and gastro-intestinal tracts have received due attention, there lies in the nasal accessory sinuses a possible source of infection which merits more attention than hitherto has been accorded to this region. Several cases have been sighted in which drainage and treatment of the accessory sinuses has resulted in relief from symptoms with great improvement in cases of arthritis.

The author states in examination of sinuses it will often be found that the patient with very badly infected sinuses with pus streaming from one or both nostrils may be in apparently good health, while another patient who has nothing but a slight nonpurulent discharge is depressed, thin and sallow and obviously in poor health. The author believes that in the pronounced infections there is a profuse outpouring of polymorphonuclear cells which wall off the infection and prevent absorption; in slight infections with few pus cells toxic absorption is more pronounced. He makes a plea for a more thorough examination of the nasal accessory sinuses in cases of systemic infection.—*L. C. Abbott, Ann Arbor, Michigan.*

TREATMENT OF GONORRHEAL ARTHRITIS BY INJECTION OF THE JOINT FLUID. MM. H. Dufour, J. Thiers, and Mme. Alexewsky. *Bull. de la Soc. Méd. des Hôpitaux*, Nov. 25, 1921.

The method of treatment consists in aspirating the fluid from the affected joint and immediately reinjecting a small amount of it subcutaneously. The dose is 10-20 c.c., and the procedure is repeated once a week as long as fluid can be obtained from the joint. In a previous article they have reported four other cases and they now report two more. Other observers have also reported results, making now a total of thirteen cases. Rapid improvement followed in all cases. One of the cases here reported was in the suppurative stage. The

joint fluid was full of leucocytes with typical intra-cellular diplococci. No local reaction has occurred in any of their cases.—*P. D. Wilson, Boston.*

CONGENITAL ABNORMALITIES.

CERVICAL RIB, WITH REPORT OF TWO CASES. Paul C. Colonna. *Am. Jour. Med. Sciences*, January, 1922.

Sixty per cent. to 70 per cent. of reported cases occur in females. It is usually bilateral, with one side much larger than the other. Although the condition is bilateral, the symptoms rarely develop before the second decade. Symptoms produced are not definitely related to the size of the anomaly.

The usual signs and symptoms are:

1. Hump-like prominence in the lateral cervical region.
2. The appearance of pressure symptoms manifested by circulatory or nervous disturbances.
3. Superficial pulsation of the subclavian artery.
4. Cervical scoliosis.

Pressure symptoms may be referable to pressure on the brachial plexus, the cervical sympathetic, the pneumogastric nerve, or the subclavian artery.

The differential diagnosis.

The conservative treatment consists of rest in bed for a few weeks with elevation of the arm, and sometimes heat, massage, electricity, etc., but most authors agree that this is a waste of time. The surgical treatment is a difficult major operation. The periosteum should be removed with the rib to prevent recurrence. The anterior approach is made by cutting the platisma, double ligation and division of the external jugular vein, exposing the great vessels and the brachial plexus, and cautiously retracting them over the cervical rib, especial care being taken to avoid the pleura. The soft parts are separated, and as much of the rib as possible is resected. The posterior approach is by a longitudinal incision, 2 cm. lateral to the spinous processes. The muscles are cut through or separated, and a curved elevator passed around the neck of the rib, and the latter is divided. The soft parts are separated from the rib, and as much as possible resected. There is danger to the nerve, especially to the serratus as it passes through the scalenus medius.

The cases reported were, in brief:

Case 1: Female, aged 24 years, with numbness of the whole right arm. The rib was exposed by the anterior incision and 1⅝ inches resected. She was completely relieved.

Case 2: Female, 21 years, complained of blue and cold fingers of the right hand. About 2½ inches of the rib were resected by piecemeal with bone forceps. Recovery uneventful.—*F. G. Hodgson, Atlanta, Ga.*

CONGENITAL DEFORMITIES AND ANOMALIES OF THE HYPOPHYSIS IN A TWIN. Nino Samaja. *Chir. degli Organi di Movimento*, Vol. 5, No. 6, December, 1921.

The paper is based upon observations of deformities made in one of the twins observed, a boy of 16.

These deformities concerned mainly the lower extremities. The right lower extremity was generally somewhat stunted in growth in comparison with the trunk and there was a dislocation of the hip. The left lower extremity was greatly deformed through maldevelopment of the extremity in all its sections so that it presented a rather small and atrophic stump which could not be used for erect posture and for gait.

The dislocation on the right side was reduced operatively; the left limb was furnished with a splint sufficient to allow walking. An examination of the hypophysis in the x-ray picture revealed the following facts:

1. The presence of a sella turcica of reduced dimension.
2. The reduction of the dimension of the sella turcica concerned both twins, although one showed a body development which was rather in excess of normal while the other had the deformities which have been mentioned.

From the study of these two cases the author finds a connection between the diminution in size of the hypophysis and the general bodily development. He points out that the finding could not be construed as a coincidence but that there is a rather definite connection between the development of the hypophysis and the occurrence of deformities or irregularities in growth in general. He admits, however, that further researches will be necessary in substantiation of his theory.—*A. Steindler, Iowa City, Ia.*

CERVICAL RIBS: WITH SPECIAL REFERENCE TO THE SURGICAL TREATMENT. Alfred S. Taylor. *N. Y. State Jour. of Med.*, March, 1922.

The first section of this comprehensive and important paper recapitulates the outstanding features of the morphology, incidence, and anatomy of cervical ribs. These ribs appear in females as compared to males in the ratio of three to one. They are usually bilateral and with rare exceptions are attached to the seventh cervical vertebra. They vary in size from a somewhat enlarged transverse process to a complete rib which articulates with the vertebra and the sternum. The size of the rib is not to be taken as an index of the severity of compression symptoms which may be set up. Indeed, the smaller and less normally formed ribs are often responsible for the greatest degrees of compression. In the more rudimentary ribs, too, there is usually found arising from the tip of the false rib an aponeurotic band running forwards and downwards to an attachment to the first true rib. Such a band causes the same symptoms as does a complete false rib. In the presence of these accessory ribs, the subclavian artery rises to a higher level, and in those cases in which the false rib is joined to an upward bony projection from the upper surface of the first true rib, the artery crosses the latter just in front of the bony projection. The subclavian vein is changed in position only when the false rib is complete and reaches the sternum. The eighth cervical and first dorsal nerve roots pass up over the false rib to join the plexus and show the results of pressure in motor, sensory, and vasomotor disturbances in their peripheral area of distribution. The author points out that the symptoms first appear at about the age of thirty and often after some debilitating illness, or operation, for some other condition. No mention is made of the relationship of the pre- and post-fixed types of plexus.

In discussing the symptomatology, it is pointed out that sensory disturbances are the first to appear, and being mild and indefinite, at first they are apt to be attributed to neuralgia, rheumatism, and the like. The pain and paraesthesia affect the ulnar side of the hand and forearm, and anaesthesia may finally supervene. A number of writers have published cases in which dissociated sensory disturbances suggested syringomyelia, and Bassoe has emphasized the fact that true syringomyelia is a not infrequent associate of cervical ribs. The signs of motor disturbance also develop insidiously and lead to atrophy and loss of power in the small muscles of the hand; claw-hand deformity may ultimately result, and the importance of operating before this terminal stage develops is stressed by the writer. Trophic vasomotor disturbances are met with in the ring and little fingers. After symptoms have made their appearance, the probabilities are all in favor of their progression, either steadily or with intermissions.

The procedures for operative removal of cervical rib have been classified into three general groups: 1. The "anterior," in which an incision is made along the posterior border of the sternomastoid muscle. It is condemned because it involves too much manipulation of the plexus. 2. The "lateral," in which an incision is made above and parallel to the clavicle or runs along the anterior border of the trapezius. 3. The "posterior," in which a vertical incision is made 2 cm. to the side of and parallel to the spinous processes of the cervico-dorsal vertebrae, giving an approach through the trapezius muscle.

The author advocates the antero-lateral mode of approach, by an incision starting at the posterior edge of the insertion of the sterno-mastoid muscle and passing upward and outward to the border of the trapezius muscle, making an angle of 45 degrees with the clavicle. The cervical fascia is divided along the outer border of the plexus, which is then separated from its bed posteriorly sufficiently to expose the rib and permit gentle retraction forward of the plexus. When the accessory rib is rudimentary and buried in the scalenus medius muscle, its location is found by feeling for the carotid tubercle as the guide. The muscular and ligamentous structures attached to the rib are divided by sharp dissection so as to leave all periosteum on the rib, and great care must be taken to preserve the pleura. The last portions to be freed are the head and neck of the rib, and the intimate relationships of the seventh cervical root and of the vertebral artery are discussed. Good illumination is necessary. After the outer portion of the rib has been freed it is grasped by forceps and a clean enucleation of head and neck attempted. If the peculiar conformation of the rudimentary rib makes the last part of the operation difficult, it may be advisable to leave the head of the rib *in situ* and divide it by small rongeurs as close up to the head as possible; the strong aponeurotic extension must be divided. The wound is closed without drainage. The operation combines the following advantages: a. It is sufficiently free to permit of complete removal and to allow control of bleeding. If the vertebral artery is injured it must be ligated at its origin. b. It permits of a minimum of manipulation of the plexus. c. The scar is inconspicuous. d. The whole dissection follows natural lines of anatomical cleavage.

The article is completed by a fully reported series of five cases and is illus-

trated by excellent photographs of the clinical features, x-rays, and specimens of removed ribs.—*W. A. Cochrane, Boston.*

OPERATIVE PROCEDURES.

ARTHROPLASTY OF THE ELBOW JOINT: A POINT OF VIEW. Harold C. Bean. *Boston Med. and Surg. Jour.*, March 9, 1922.

Reports of operators are rather misleading as to advisability of this procedure in the hands of the average surgeon, the author believes. Because of the importance of the prerequisites, the length of time necessary for end-results, the lack of definite predictions as to outcome, except in a very limited number of cases, he has yet to see the advantages of a few degrees of stable motion over an ankylosis in favorable flexion or an excision with a moderately flail joint. He thinks careful selection of cases and an exact technic by an experienced operator in such cases are essential to a good prospect of success. He favors the MacAusland operation.—*R. W. Billington, Nashville.*

STIFF FINGERS. F. J. Cotton and E. J. Sawyer. *Boston Med. and Surg. Jour.*, Feb. 9, 1922.

For stiff finger-joints the authors employ continuous traction combined with a gradual flexing or extending force to overcome the soft tissue resistance. Special splints and their application are illustrated. Eight cases are reported. No credit is given for the extensive use of this principle and some very similar splints by both British and American orthopaedic surgeons during the war, where it was found that this method gave best results when combined with and followed by physiotherapy. The authors rather discredit the value of physiotherapy in these cases.—*R. W. Billington, Nashville.*

METHODIC MOBILIZATION IN THE TREATMENT OF ARTICULAR AFFECTIONS. Kouindjy. *La Presse Médicale*, January 11, 1922, p. 42.

The recent revival of the mobilization method in treatment of joint lesions only confirms the principles established in 1841 by Teissier of Lyon. He proclaimed that prolonged immobilization is dangerous, not only for pathologic joints but for normal joints.

A perfectly sound joint held in absolute immobility may become stiff or even ankylosed by changes in the synovial membrane and cartilages. Teissier examined many joints at autopsy of patients who had died after prolonged fixation of a limb for fracture. He found almost constantly that the normal synovial fluid was replaced by a sero-sanguinous material. This extravasation was found not only in the joint cavity, but in the extra-articular soft parts. The folds of the synovial membrane were swollen and reddened as though by a passive hyperemia and adherent more or less to the cartilaginous surface. All this may occur in case of lesions for which immobilization has been maintained for two or three months, *i.e.*, the time required for healing a fractured femur. But when, because of delayed union, this form of treatment is kept up for six

or eight months, or even longer, there may occur in previously healthy joints a condition a hundred-fold worse than the original fracture.

The author has quoted quite extensively from Teissier as above in order to emphasize the teachings which this clinician put forth about eighty years ago.

To illustrate the development of ankylosis a case is reported of a patient 20 years of age who had an attack of multiple arthritis resulting in a painful right knee. After two months in the cast, a roentgenogram of this knee showed normal joint surfaces, but after five months another picture revealed a loss of normal contour of these surfaces and a marked narrowing of the space separating them. Owing to lack of the patient's coöperation, the leg could not be mobilized and the knee continued to grow more and more stiff until a roentgenogram taken a year after the lesion appeared showed a complete bony ankylosis. —*William Arthur Clark, Pasadena, Calif.*

Leveling (Balancing) the Pelvis in Cases of Inequality of Length of Legs, with a Description of a Pathognomonic Sign. Philip Lewin, M.D. *Jour. A.M.A.*, March 18, 1922, page 804.

This case report concerns a girl of 17 with infantile paralysis which had resulted in two inches of shortening of one leg. From this shortening resulted a marked scoliosis towards the affected side, which scoliosis was made to disappear by raising the short leg and so balancing the pelvis. The importance of such pelvic balancing or leveling is emphasized in all cases of scoliosis accompanied by a short leg. Attention is drawn to the importance of difference in level of the posterior superior spines in cases of short leg, as also of difference of level of the gluteal creases. When such phenomena occur the pelvis may be assumed to be depressed on one or other side, a condition necessarily to be corrected in the treatment of an accompanying scoliosis.—*J. A. Nutter, Montreal.*

Amputations at the Shoulder and at the Hip. H. Littlewood. *British Medical Journal*, March 11, 1922, page 381.

The author notes that he described his operation for removal of the upper extremity ten years ago, but in this article describes it in fuller detail. His operation differs from that described by Prof. Berger in that the approach to the vessels is made from behind and in Berger's operation preliminary ligation of the vessels is done. Littlewood believes that his operation is preferable because it gives easy access to the vessels and the operation can be done in a shorter time.

Description of the Operation.

Two flaps are formed, a cervico-scapular and a pectoro-axillary. The patient is placed on the sound side close to the edge of the operating table. A cervico-scapular flap is made, commencing at the clavicle near the outer margin of the sterno-mastoid attachment, carried along the clavicle over the prominence of the shoulder along the axillary border of the scapula to a point below the angle and backwards to about two inches from the spine. A flap of skin and subcutaneous tissue is rapidly turned back; this exposes the posterior surface of the scapula with muscle attachments. The trapezius and latissimus dorsi are

divided, next the levator anguli scapulae, the rhomboids, and lastly the scapular attachments of the serratus magnus and omo hyoid. Three or four vessels may require ligature, branches of the supra-scapular and posterior scapular arteries. The soft tissues are now separated from the clavicle close to the sterno-mastoid attachment, and the bone divided by Gigli saw. The whole extremity now falls away from the trunk, held by the subclavian vessels and the cords of the brachial plexus, which are fully on the stretch, standing out and easily seen. The cords of the plexus are now divided, clips applied to the subclavian artery and vein. The anterior pectoro-axillary flap is reflected as far as it is found necessary. The last stage of the operation consists of the division of the pectoralis major and minor. The forequarter is then removed and this exposes the thoracic boundaries of the axilla and the posterior triangle of the neck so that lymphatic glands can be removed.

Amputation Near the Hip-Joint. (Supratrochanteric.)

The author first performed the operation in 1897. The object is to leave the hip-joint intact and there is less shock than in the operation for disarticulation.

Description of the Operation.

An anterior internal flap is formed beginning just below the anterior superior spine of the ilium, coming down to a level to provide for an adequate covering of the stump—that is, one-third of the thigh's circumference, then over the front of the thigh and upward to the inner and posterior aspect near the tuberosity. The posterior external flap is now made. The anterior internal flap is now dissected upwards and the femoral vessels are ligated. This is followed by division of the muscles and ligation of the branches of the profunda. The muscles of the posterior external flap are then divided. The flaps are then held aside and the anterior portion of the capsule attached to the trochanteric line is reflected upward for a distance of one-half inch. The neck of the femur is then divided close to the trochanter and the extremity removed.

In excisions Littlewood does not use the tourniquet because he has found that there is less oozing post-operatively. This principle he has applied to amputations.—*L. C. Abbott, Ann Arbor, Michigan.*

THE TREATMENT OF ARTHROGENETIC CONTRACTURES OF THE KNEE WITH PARTIAL ALCOHOLIZATION OF THE SCIATIC NERVE. Dario Maragliano. *Chir. degli Organi di Movimento.* Vol. 5, No. 6, December, 1921.

It is well known that inflammatory conditions of the knee cause very early flexion contractures of this joint. This contracture in the early stages of the inflammation is due to reflex action caused by the irritation of the sensory nerve endings in the synovial lining and in the capsule.

Jansen has advanced the theory that in the knee as well as in other articulations the contracture due to reflex spasm is maintained mainly by the polyarticular muscles, and, in much lesser degree only, by the monarticular muscles. In the knee-joint the extensors are almost entirely monarticular, while the flexors of the knee are all polyarticular muscles, and from this point of view the early tendency to contracture of this joint may be explained.

Other conditions contributory to contracture may be the atrophy of the extensors, the structural shortening of the flexors, the distention of the capsule and the organization of the exudate. In this publication the author deals exclusively with such flexion contractures as occur in the wake of an inflammatory process in the knee and in which there is a certain residual motion. The ordinary curative methods of correction of deformity are the forcible redressment, tenotomies and tendon lengthening and the supracondyloid osteotomy. It appears to him a logical procedure to influence directly the innervation of the flexor muscles in such a manner that the centripetal stimulus is eliminated or weakened.

At the lower border of the gluteus maximus the muscle fibers supplying the long head of the biceps, the semi-tendinosus, and semi-membranosus are found all together in a common bundle, so that it is easy to isolate these nerves from the trunk of the sciatic nerve. By interruption of the conductivity of the nerve fibers of this bundle, two results are obtained: 1. That of elimination of the centripetal stimuli, and 2, the diminution of the motor reaction.

It appeared to the author that a complete or anatomical interruption was not a desirable object. Rather than that, the interruption should be only a physiological one. This may be obtained in three ways: by ligature of the nerve with catgut; by freezing methods according to Trendelenburg; and, finally, by alcoholization with 60 per cent. alcohol.

The idea of alcoholizing nerves in order to eliminate contracture is not new. Among others, Sicard and Imbert applied this method in muscle contractures subsequent to war wounds.

The clinical results obtained by the author in three cases demonstrate that the diminution of the flexor action of the semi-tendinosus, semi-membranosus, and biceps, by alcoholization of the nerve trunk, eliminates the most obstinate flexion contractures which follow inflammatory conditions in the knee.

In two cases the alcoholization gave a very good result, such as even a very prolonged redressment procedure would not have obtained. In the third case there was an almost right angular flexion contracture due to tuberculous synovitis. The alcoholization obtained correction after only one month of redressment, which correction maintained itself during twelve months of observation.

It is important to know that in the experiments different animals react differently to alcoholization; in dogs a complete paralysis, sensory as well as motor, ensues, but the pathological lesions which are found at the point of injections do not involve all the nerve fibers. In all experiments of the author, as well as in those carried out by others, it was constantly found that certain sections or nerve bundles escape the action of the alcohol to a greater or less degree.

Petries and Marchant, who carried out similar experiments in 1917, attach great importance to the use of alcohol of 60 per cent. strength, in which concentration the motor conductivity is interrupted without altering the sensory conductivity. With this opinion the author takes decided issue. The alcoholization of the mixed nerves in men show distinctly that the sensory conductivity as well as the motor conductivity is suspended. It is well known that the first attempts to cure the neuralgia of the sciatic nerve were discouraged by the fact

that motor paralysis developed together with sensory paralysis. There is one point, however, that must be admitted, and that is, that there is a certain difference in the degree of action of these inter-nervous injections of alcohol in different species of animals. The author observed that rabbits are affected to a much higher degree than dogs.

In conclusion the author feels that the alcoholization of the nerve bundles can be justly proposed as an effective means to combat flexion contractures in the knee by eliminating the contracture of the semi-membranosus, semi-tendinosus, and of the long head of the biceps.—*A. Steindler, Iowa City, Ia.*

EXPERIMENTAL LENGTHENING OF THE LIMBS. O. Nuzzi. *Chir. Org. Mov.*, Vol. 6, No. 1, 1922.

The division of bone for the purpose of operative lengthening may be accomplished by oblique osteotomy, by z-shaped osteotomy of Vulpius, by the U-shaped osteotomy of Fassett, but the best method is considered that of Putti, who divides the bone in Z fashion, incising the periosteum in the same manner, only with the short branches of the Z cut in opposite direction. The longitudinal cut through the bone is made by the circular saw, as is also the, horizontal cut of the outer half, while the horizontal cut of the inner half is carried out by means of a Gigli saw.

The point of election for the osteotomy is not the place of the deformity itself, but a point at some distance from it, mainly because of the danger of infectious material harbored in the callus, and also because of the insufficient osteogenetic qualities of the callus. The maximum lengthening cannot be obtained in one sitting, but must be attempted gradually. Putti obtains it in from 20 to 30 days.

For the purpose of lengthening the bone, Putti has used since 1917 an instrument which he calls the osteotone. and which he described then in his article on traction by double skeletal transfixion. This osteotone is capable of producing a constant, gradual, and calculable amount of traction or distention of the bones.

It is necessary to know something about the elasticity of the contracted soft tissues, especially the muscles, nerves, and fascia, in order to judge the amount of lengthening obtainable.

The author has carried out extensive experiments on rabbits in order to study the amount of lengthening of these tissues obtained by certain degrees of traction forces. From his experiments, which were carried out under strict dynamometric control, he finds that it is possible to lengthen the normal limb by direct traction upon the skeleton. Regarding the elasticity or the amount of lengthening obtainable by certain force, the different tissues act differently among themselves, and there is also a difference between the living and the dead animal as well as a difference between the lengthening obtainable in one sitting and that obtainable in several sittings. He finds that in living elastic tissue, there is normally a certain unused power of elasticity which can be made use of in operative lengthening of the extremity. The lengthening has to be tolerated if carried out in repeated sittings.

In regard to the vaginal fascia, the author finds that sectioning of the fascia increased the amount of lengthening possible. The force required for a certain amount of lengthening after sectioning the fascia decreases to about one-fourth of the force required with the fascia intact. It therefore seems that the deep aponeurosis of the thigh absorbs about three-fourths of the weight necessary to produce a certain amount of lengthening of the limb.—*A. Steindler, Iowa City, Ia.*

THE POST-OPERATIVE TREATMENT IN CERTAIN SURGICAL PROCEDURES ON THE UPPER EXTREMITY. Arthur Steindler. *Chir. degli Organi di Movimento*, Vol. 5, No. 6, December, 1921.

The conclusions of the author are as follows:

1. Following the operation it is necessary to provide an adequate period of rest and absolute fixation in order to re-establish the tissue equilibrium, and in order to restrict as much as possible the local operative reaction.

2. The relaxation of the muscles involved and the absolute avoidance of fatigue to which weakened muscles are inordinately susceptible is a necessary principle.

3. It is necessary to institute the re-education of muscle power, and this re-education must start from positions of absolute rest.

4. It is necessary to institute systematic development of the muscles of the neighborhood and of such muscles which take care of compensatory motion.

5. It is necessary to interpose a phase of muscle education between the mechanical treatment and the occupational therapy.

6. It is necessary that this intermediate phase be governed by a system of standardization which concerns the objects used, the movements selected and the promptness and velocity of motion to be obtained. For the graphic demonstration of results obtained by this intermediate method of muscle education under standardized rules, graphic curves can be drawn which can be reduced to a percentage basis by comparison of the affected extremity with the sound one.—*A. Steindler, Iowa City, Ia.*

NEOPLASMS.

JOINT MYXOMA. G. Bolognesi. *Chir. Org. Mov.*, Vol. 6, No. 1, 1922.

One case of myxoma of the knee-joint observed by the author is minutely described. In the histological examination, the entire synovial layer was found transformed into a myxomatous tissue. The anatomical diagnosis was a pure and simple myxoma diffusing into the synovial membrane of the knee-joint with a focus of an osseous myxoma in the internal condyle of the femur.

The clinical picture of the patient pointed to an endosynovial lesion which developed after a trauma upon which a hemarthrosis and later a secondary traumatic arthritis followed. The clinical course might have caused suspicion of a tuberculous arthritis, but the findings at operation rather permitted the assumption of a myxomatous tumor developing on the basis of an inflammatory

process subsequent to trauma, and this diagnosis was finally confirmed by the histopathological findings.

The symptoms presented in this case were briefly the following: A more or less diffused swelling of the knee with dilatation of veins of the skin; pain upon exploration was located in the joint line but was neither constant nor very intense. Motion in the joint was at least partially preserved, a symptom which the author thinks is of importance in differentiation from an inflammatory condition of the joint.

Joint tumors might clinically be distinguished in the following groups:

(1) Circumscribed tumors with small nodules; sometimes pedunculated;

(2) Larger tumors always localized in a certain section of the articular capsule, and

(3) Diffused tumors of the synovial membrane.

The circumscribed tumors are more often benign, while the diffused tumors are usually of malignant character. Nevertheless, one may observe lipoma or fibroma of diffused character.

In regard to the differential diagnosis of the articular myxoma, tuberculous fungous arthritis is first to be considered. In this respect, the good general condition of the patient in myxoma is of importance. There is also the absence of signs of scrofulosis or adenopathy and of other tubercular lesions to be noted. The joint pain, especially spontaneous pain, is much less than it is in fungous disease. In spite of the sometimes considerable extent of the tumors in the joint, there is no periarticular infiltration in myxoma, and the movements in the joint are at least partially preserved.

The radiological examination does not give definite information. The picture found in these tumors might apply to chronic osteomyelitis or syphilitic arthritis or rarefying osteitis or tuberculosis.

The surgical interference in these tumors may consist either in local removal of the tumor or in total resection of the synovia, or in joint resection, or, finally, in amputations. In his case, the author carried out the articular resection, which is sufficient when the following examination shows that the tumor is benign.

The pure myxoma consists of an embryonal tissue and is one of the rarest forms of neoplasm. It has been found in certain internal organs, in the subcutaneous tissue of the umbilical region, in the periosteum, in the aponeurotic fascia, in the muscle sheath, in the connective tissue of the mucous membranes, in the connective tissue of the bone marrow, and in the nerves. Mixed forms, such as chondro-myxoma and myxo-sarcoma, etc., are by far more frequent. The case of the author is to be regarded as most exceptional because of the simplicity and purity of the histological picture. The author believes that the primary myxoma of an articular cavity offers symptoms similar but not quite identical to those of fungous arthritis.—*A. Steindler, Iowa City, Ia.*

OSTEOMATA OF THE BRACHIAL TRICEPS. Massart. *La Presse Médicale*, January 25, 1922, page 130.

Most of the studies devoted to osteomata in the region of the elbow do not mention the rather rare occurrence of these growths in the triceps. Only five

cases were found in the literature previous to the two cases reported by the author.

Case 1. A chauffeur, who, when three years old, had broken his olecranon, now shows normal motion and appearance of the elbow except for two bony masses visible and palpable above the olecranon in the triceps tendon. Roentgenogram of the original fracture in 1902, when the patient was a child, shows an incomplete fracture of the olecranon. The present roentgen picture suggests that the osteomata are the result of callus thrown out in repairing the old fracture. The two bony growths are about the size of almonds and are separated by a space of only 2 mm.

Case 2 is a child of 10 who had a comminuted fracture of the right radial head in 1915. At present he shows normal flexion but limited extension and rotation in the elbow. Roentgenogram shows an osteoma on the posterior aspect of the humerus between the condyles; apparently an intra-articular callus.

The origin of these osteomata is a subject for more or less theoretical discussion. In the first case the original roentgenogram gives evidence against the idea of aberrant callus formation. The theory of dislodgment of part of an epiphysis still cartilaginous and developing into bone in its new position is scarcely tenable. The most probable theory is that of periosteal origin, a portion of periosteum being torn off at the time of the fracture and producing the bony growth in the site where it lodged.

In the second case, however, the osteoma seems to have developed from the olecranon, probably as a result of the trauma at the time of the fracture, which caused a disturbance in ossification of the epiphysis.—*William Arthur Clark, Pasadena, Calif.*

SARCOMA OF THE LONG BONES. (A STUDY OF MICROSCOPICALLY PROVEN CASES.) H. W. Meyerding. *Surg., Gyn., and Obstet.*, March, 1922, page 321.

Four hundred and seventy cases of sarcoma of the extremities were seen at the Mayo Clinic from 1907 to 1921. Thirty-five per cent. of these, or 168, were sarcoma of the long bones, and only 65 per cent., or 109, of the sarcomata of the long bones were operated upon. The remainder, 35 per cent., were inoperable or the patient refused operation.

The author's report is based on 109 cases which were operated upon. The article is illustrated with photomicrographs of sections of these tumors and x-rays of the lesions.

The types of sarcoma were classified as mixed-cell sarcoma, round-cell sarcoma, osteo-sarcoma, chondro-sarcoma, and fibro-sarcoma. The most malignant type found was the osteo-sarcoma; the most common type was the mixed-cell sarcoma, and the least common was the fibro-sarcoma. The so-called foreign body giant-cell tumors are not included in this report because they are considered benign tumors.

In discussing the etiology of sarcomata, he mentions local trauma and inflammatory process of bone as possible factors. In his series, 53.2 per cent. of the cases gave a history of trauma. The average age was 26.7 years, and the common age was between 10 and 40 years.

Clinically, the diagnosis of sarcoma of the long bones is not always easy. It must be differentiated from benign neoplasms such as foreign body giant-cell tumors, chondromas and fibrocystic disease, from syphilis and osteomyelitis. The diagnostic value of x-ray is frequently overestimated. It is helpful in determining the exact location of the tumor, the extent of its growth, and gives us the earliest evidence of lung metastasis, which is the most common complication. Routine x-ray examination of the lungs should be made in every case to rule out metastasis.

The treatment is dependent upon the duration, site, and extent of the lesion. Non-surgical cases are treated with Coley's toxins, radium, or x-ray. If the treatment is surgical, the growth is eradicated locally by cautery, by excision, or by amputation, followed by non-surgical measures. He emphasizes the fact that before any radical operations are performed, the tumor should be explored and the diagnosis of sarcoma made by the microscopic appearance of the tumor. This should be a routine procedure in every case of suspected sarcoma. Sixty-six patients had amputations, and 21 of these, or 31.8 per cent., died of metastasis to the lungs. Nineteen patients had excisions and cautery, and 10 of these, or 52.6 per cent., have died. Twenty-four had local operations of various types. Eighteen patients, or 16.51 per cent., lived five years or more after operation. In every case, the diagnosis of sarcoma was made by the pathologist from the study of microscopic sections. Whenever possible, sections were obtained from the old fixed specimens and the diagnosis of sarcoma confirmed.

In conclusion, he emphasizes the value of making a differential diagnosis from benign bone tumors, syphilis, and osteomyelitis, and of excluding metastasis to the lungs. In every case the tumors should be explored before any surgical measures are attempted, and the surgical treatment should be followed by the administration of radium or Coley's toxins.—*Pio Blanco, Rochester, Minn.*

METABOLIC DISEASES.

PAGET'S DISEASE. Babonneix, Denoyelle, and Perisson. *Bull. de la Soc. Méd. des Hôpitaux*, December 2, 1921.

The authors report a case of Paget's disease in which the bony lesions involved chiefly the tibiae. The question of interest was chiefly whether it should be classified as true Paget's disease, since it did not conform to the classical type. They point out, however, the frequency with which single lesions are found and that they should be considered true Paget's disease. They agree with other French writers in accepting syphilis as the cause, although the Wasser mann reaction is frequently negative.—*P. D. Wilson, Boston.*

RELATION OF ACROMEGALY TO THYROID DISEASE, WITH STATISTICAL STUDY. J. M. Anders and H. M. Jameson. *Amer. Journal of Med. Sciences*, February, 1922.

Acromegaly is due to hyperactivity or perversion of the secretion of the pituitary body. The sella turcica enlarges as the affection develops. Acromegaly may develop with a normal pituitary, and destructive lesions of this gland may occur without symptoms of acromegaly.

Hypertrophy of the pituitary may occur after removal or disease of the thyroid. Conversely, experimental and operative hypophysectomy has produced changes in the thyroid. Without doubt these two glands exhibit points of resemblance, histological, physiological, and clinical. Two cases of acromegaly in which there was modification of the function of the thyroid are reported in detail by the authors.

There is subjoined a statistical study of 215 cases with a view to indicating the true pathological relationship between the disease of the hypophysis and the thyroid. Thirty-three per cent. of these cases of acromegaly showed evidence of associated disturbance of the thyroid function. The cases showing hypothyroidism were decidedly improved by the use of thyroid preparations in their treatment.—*F. G. Hodgson, Atlanta, Ga.*

Intermittent Hydrarthrosis. A. L. Nielson. *Jour. A.M.A.*, February 18, 1922.

This is a case report of a rare condition with as yet no satisfactory explanation of either etiology or pathology. The patient, an unmarried woman of 38, had recurring attacks of painful swelling in her left knee, for which immobilization as well as drainage had been tried with only temporary relief. For six years the swelling occurred at irregular intervals, but since 1913 attacks of swelling occurred about every 10 or 11 days, reaching a maximum at the second day and disappearing by the fourth day. No treatment was of avail, though an elastic bandage gave some comfort. Examination of the patient was negative except as regards the knee. X-rays of joint were negative. Patient gave a history of scarlet fever in childhood, influenza in 1919, and attacks of "inflammatory rheumatism" in 1909 and 1912. Patient is able to carry on her work as stenographer and walks several blocks daily. Moderate exercise seems beneficial.—*J. A. Nutter, Montreal.*

Pseudo-Coxalgia (Osteochondritis Deformans Juvenilis Coxae: Quiet Hip Disease). A Clinical and Radiographic Study. Harry Platt. *British Jour. of Surgery*, January, 1922.

This article represents a thesis on the subject of pseudo-coxalgia based upon an analysis of three hundred hip joint conditions and of more than a thousand radiograms from the Orthopaedic Service of the Ancoats Hospital, Manchester, England. The whole question is gone into in the most comprehensive manner possible and the author is to be congratulated upon a brilliant presentation of work well done, which aims at the establishment of pseudo-coxalgia or osteochondritis deformans juvenilis coxae as a definite entity representing the reaction of the metaphyseal region of the upper end of the femur to the stimulus of an infective agent of attenuated virulence.

The condition is comparable with the arthritis deformans juvenilis coxae which is seen solely in adolescents and which represents at this age period the reaction of the hip-joint to an infective agent of a similar type. The whole clinical and radiographic picture is in accordance with this point of view, and the histological investigations in the operated cases, particularly the report by Phemister, support the explanation. In this connection a close study of hip-

joint conditions presented in Group 4 of his series, in which it is pointed out that there exist deformations of infective origin wherein flattening of the head of the femur is the outstanding feature and which should not be included in the category of pseudo-coxalgia, should be made in the accurate labeling of pseudo-coxalgia.

The whole cycle of radiographic changes is peculiar to pseudo-coxalgia alone and they precede and outlast the clinical phenomena. Deformation of the head of the femur with flattening and expansion is seen also in conditions distinct from pseudo-coxalgia in childhood, but there is no evidence to show that in these conditions the typical structural osseous changes of pseudo-coxalgia have preceded the stage of flattening. In the condition known as Köhler's disease of the tarsal scaphoid and apophysitis of the tibial tubercle, bony changes parallel to those in pseudo-coxalgia are found, and provide one of the main arguments presented by Fromme in classing the three conditions under the generic term of "late rickets." Conservative treatment has no proved influence on the train of morbid changes, but its appreciation is indicated during the stage of prominent symptoms. Operative treatment directed toward the removal of the dominant lesion has no present place in the therapeutics of the disease.

In a recent case seen at operation by the abstractor it was noted that the joint presented no variation whatever from the normal and that in the presence of the typical radiographic appearances, the head was smooth and globular as in the normal femur in virtue of its cartilaginous elements being intact. While in no way attempting to challenge the soundness of the proposed explanation as to etiology and pathogenesis presented by such an authoritative monograph, it should be observed that recent discussion with recognized authorities in Boston suggests that more extensive evidence from histological examination in these cases must be acquired before conviction as to the infective nature of pseudo-coxalgia becomes complete.

The subject is treated systematically and the claims to priority for the discovery of pseudo-coxalgia of Legg, Calvé, and Perthes receive judicial consideration. The contributions of these and other investigators have now put more than three hundred cases on record, the largest series being those of Legg and Sundt, who have collected fifty-five and seventy-five cases respectively.

In the first main section of the article the attempt is made to investigate the complete clinical life history and cycle of bony changes in a series of thirty-five cases grouped as follows: (1) Pseudo-coxalgia in childhood, eighteen cases. (2) Pseudo-coxalgia, the end-result in adult life, five cases. (3) Arthritis deformans juvenilis coxae, five cases. (4) Miscellaneous hip-joint affections in which flattening of the head of the femur is seen, coxa plana, seven cases. A complete case history is given with each case and x-ray photographs. Then is taken up the minutiae of the symptomatology and the exact nature of the radiographic changes. The whole gamut of changes in contour and internal structure which take place in the head, neck, and acetabulum are analyzed in all their phases and the author insists that the alterations in the acetabular roof have the same specific significance as the regular pattern condensation zones of the femoral neck as regards pathogenesis. The acquisition of a permanently de-

formed head is considered to be the rule in the vast majority of cases as an end-result, but with a functionally useful limb nearly as good as normal, more subject, however, to the effects of trauma, strain, and infection, leading in two cases in Group II to definite evidences of secondary arthritis.

The next main section of the paper is a critical review as to pathogenesis and factors in etiology. It is maintained that there is a mere chance association between the development of pseudo-coxalgia and the part played by trauma or by rickets. The evidence which supports the author's conception of the disease as essentially inflammatory is next developed in a masterly thesis, and considerations as to treatment complete the investigation. None of the writer's series was operated upon.—*W. A. Cochrane, Boston.*

ISOLATED DISEASE OF SCAPHOID BONE OF FOOT. A. S. Risser. *Jour. A.M.A.*, March 4, 1922.

A case report of a rare disease (called by some Köhler's disease) involving the scaphoid in children and limited to this bone. It is a lesion of obscure etiology, while knowledge of its pathology is necessarily to be obtained almost wholly from a study of the x-ray findings. The patient, a boy of six, without definite history of trauma, presented a limp and a flat foot, though he was able to continue at his play. There was great tenderness over the scaphoid, with marked redness, heat, and swelling. Transient fever was present, though this may have been due to other causes. The tonsils were the seat of repeated attacks of inflammation, while tonsillar and cervical glands were slightly swollen. The x-rays showed a scaphoid smaller in all dimensions than normal, but especially flattened antero-posteriorly. A plaster cast was used for a few days only, after which no treatment was employed. The limp and pain gradually disappeared and with it the x-ray changes. In six months there were no signs, symptoms, or changes to be seen in the x-rays.—*J. A. Nutter, Montreal.*

MISCELLANEOUS.

CONTRIBUTION TO THE KNOWLEDGE OF BERTOLOTTI'S SYNDROME. Armando Albanese. *Chir. degli Organi di Movimento*, Vol. 5, No. 6, December, 1921.

Credit is due to Bertolotti for having thrown light upon a number of cases of uncertain diagnosis, often considered as sciatica and lumbago, by means of his radiological examinations. These examinations centered in the cognizance and description of the abnormal development of the lateral processes of the fifth lumbar vertebra and of the relations of this structure to the sacrum and to the iliac bones. In this country Adams and Goldthwait have already given close attention to the sacralization of the last lumbar vertebra. Following Bertolotti's work, both the clinical and radiological observations increased very rapidly. One of the largest contributions is that of Rossi, who bases his investigation on eight hundred radiological examinations.

The author describes a series of six cases in which the radiological examination showed either unilateral or bilateral sacralization. The clinical signs

which accompanied this condition were those described by Bertolotti, and consisted in neuralgic symptoms extending on both sides of the lower extremity, having the character of sciatic or lumbo-sciatic neuralgias. The pain was of indistinct radiation and of extremely varying intensity, showing ample remissions and recrudescences. There was always difficulty in forward flexion of the trunk and in locomotion. Horizontal position did not bring relief in all cases and in no case was there a traumatic or infectious agency noted in the history.

In one case only a hypertrichosis over the sacrum was noted and a cleft in this bone was found in the x-ray picture. In two cases, however, there existed aside from the malformation of the fifth lumbar a so-called spina bifida occulta, an observation which concurs with observations of Putti, Bertolotti, and Rossi.

In addition to these observations the author has made investigations on twenty-five skeletons of fetuses or new-born children. In two of these cases there was an assimilation of the fifth lumbar to the first sacral. Looking over the literature, there is found considerable discrepancy in the data regarding the frequency of anomalies in this region, especially great in the examination of children, in whom a large part of the vertebrae is still cartilaginous. LeDouble found six sacral vertebrae only twice among two hundred cases, while Böhm, among twenty-five skeletons examined, found sacralization in twenty-two cases.

Further investigations were carried out by the author on 780 sacral bones found in the monastery of the Capuchins in Rome. Of these 780 sacra, thirty-three, or 4.2 per cent., had six vertebrae.

Among these thirty-three the author observed the existence of a rachischisis but three times.

On the other hand, only five cases showed four sacral vertebrae instead of five.

Further observation was carried out on twelve skeletons of inhabitants of the Fire Islands. The findings in this group of cases are especially interesting. In five instances there were anomalies of differentiation noted in the fifth lumbar vertebra. These anomalies consisted in sacralization and hemi-sacralization, and in three out of five cases there was a cleft of the spine, due to lack of fusion of the posterior processes of the first sacral, in two cases, and due to lack of fusion of the spinous processes of the fifth lumbar, in a third case. Especially noteworthy was the high percentage of sacralization in skeletons of this race, namely, 41.6 per cent.

While it must be admitted that the transformation of the fifth lumbar reaches back into early periods of formation of the spine, the explanation of the slow onset of the manifestations at a comparatively late period of life presupposes that a new factor arises which causes the hitherto latent condition to produce clinical symptoms.

The presence of the sacralization of the fifth lumbar in itself does not necessarily mean the appearance of Bertolotti's syndrome. By the same token it is known that numerous individuals having a cervical rib carry this through life without any clinical symptoms.

The slow appearance of the symptoms must therefore be assumed to be in connection with the developing static conditions of the vertebral column arising on the occasion of the final ossification of the lumbo-sacral region, and this usually takes place before the age of 25 to 30.

In conclusion, the author is in position to confirm from his observation not only the presence of the clinical symptoms known as Bertolotti's syndrome but also to explain their late onset beyond the age of 20.

Comparing his clinical observations with his anatomical findings on twenty-five children and on 780 sacral bones of European races on one hand, and with the twelve skeletons of the Fire Island inhabitants on the other, the frequency of rachitic clefts and of sacralization of the lumbar vertebrae in the latter is striking. While among European races not more than 4 per cent. show sacra with six vertebrae, it is found in fully 41 per cent. among the Fire Islanders. The presence of this phenomenon in such frequency among an inferior race gives rise to the suspicion that the sacralization of the fifth lumbar is a reversion to type and a form of atavism.—*A. Steindler, Iowa City, Ia.*

ACUTE OSTEOMYELITIS. I. Cohn. *New Orleans Med. and Surg. Jour.*, January, 1922.

Osteomyelitis is a crippling disease when not recognized early and should be diagnosed early enough to prevent the formation of sequestra. The paper is based on the following:

1. Osteomyelitis is a blood-borne disease.
2. It localizes primarily in the medullary canal.
3. There are no early x-ray findings on which a diagnosis can be based.
4. Early diagnosis must be made if we expect to cure the patient without prolonged treatment and multiple operations.
5. The early operative findings may be only a fat necrosis of the medullary contents without frank pus.
6. Early operation should give almost instant relief from pain, a subsidence of temperature, and an early recovery, with perfect restoration of function.
7. Early operation should not be followed by sequestrum formation.
8. Early diagnosis and operation should remove osteomyelitis from the class of chronically disabling diseases.

The x-ray is of negative value and the diagnosis should be made before it is possible to make anything out in the skiagraph. When the diagnosis is made operation should be done at once, preferably with motor-driven instruments. The medullary canal should be opened, even if pus is found under the periosteum, because it is sure that the infection has reached the cortex through the Haversian system. The use of the curette is decried. Four cases are reported.—*Edward S. Hatch, New Orleans, La.*

OSTEOCHONDRITIS OF RIBS FOLLOWING TYPHUS FEVER AND ITS TREATMENT BY INJECTIONS OF IODINE. Nadine Dobrovolskaia (Prof. de Chirurgie, Univ. de Voronège, Russie). *Presse Médicale*, December 3, 1921.

Lesions of the above nature are well known among the complications of typhoid and paratyphoid fevers. However, Dobrovolskaia has been unable to find any mention of them among the described complications of typhus fever. They were observed, nevertheless, in numerous cases during the 1919-1920 epidemic of typhus among the refugees of Southern Russia, and they proved very

refractory to ordinary methods of treatment. They developed during the period of convalescence, or from several weeks to several months after the fever. Clinical features agreed with those of similar lesions following typhoid fevers, often with severe pain in the indurated lesions. Bacteriological study was hampered by conditions under which the work was done. Pus from closed abscesses was sterile. Smears were negative for tubercle bacillus. Wassermann test negative, except in a few cases.

The following methods of treatment were worked out in the hospital where the author studied them, in Egypt. General measures included rest, open-air life, forced feeding, symptomatic medication. Heliotherapy, proceeding gradually, from initial small dosage, for the majority of the cases. As these were seldom sufficient to effect a cure of the rib lesions, the following procedure was added. As proposed and used, with good results, by Hotz and Kanevskaia, in Russia, in cases of surgical tuberculosis, intramuscular injections of iodine with iodoform. The preparation—10 per cent. tincture iodine with 10 per cent. iodoform in paraffin oil—is freshly made before using, and is injected under local anaesthesia, into the buttock, with an initial dose of 3 cc., increasing to 10 cc., at intervals of one week. According to Hotz's theory, fat-splitting ferments are set free in the lymphocytosis provoked by the iodine injections, making more vulnerable to attack organisms like those of tuberculosis and leprosy. In addition to the injections, alternating areas on various parts of the body are painted with iodine every few days. Local treatment is simple; aseptic dressings, soap poultice, or camphorated oil for painful indurations.

From his personal observations Dobrovolskaia believes these post-typhus lesions differ in no important respect from the post-typhoid; that, admitting the probability that in either group the specific organism of that group is a factor, such lesions develop only in favorable soil, such as furnished by latent tuberculosis, or occasionally syphilis. The foregoing method of treatment by attacking one of these agents renders the other more subject to control. The results have been definite—complete cure in a majority of the cases; convalescence established in the more stubborn cases. Treatment is protracted, but hospitalization is not essential. Care is required in dealing with patients who have an idiosyncrasy for iodine. When indicated, antispecific treatment is demanded as well.—*Roades Fayerweather, Baltimore, Md.*

RESEARCH ON THE DEVELOPMENT OF THE JOINTS. Giulio Faldino. *Chir. degli Organi di Movimento*, Vol. 5, No. 6, December, 1921.

The study of different embryos proved that beginning with the first phases of development there exist certain articulations which develop normally in their differentiation of an epiphysis and articular cavity, while others in the same embryos remain at this time absolutely undifferentiated. Among the first to become differentiated are the shoulder-joint, the elbow-joint, the metacarpophalangeal joints, the hip-joint, and the tibio-tarsal joints. There are undoubtedly joints which are necessarily in function in very early stages of embryonal life, and, on the other hand, others in which no function appears during this stage. The author has observed that differentiation occurs much earlier in those joints which in embryonal life maintain a flexion position. It is obvious,

therefore, that something outside of the joint is acting which determines differentiation, and this agency he believes to be muscle action. The tendons develop very early, and in regard to differentiation the author has observed that the tendons of the flexor muscles precede considerably those of the extensors. This difference in development of tendons existing among the diverse groups must serve as an explanation of the fact that some articulations develop early, while others lag behind. Comparing the time of development of these organs which supply the mechanism of joint motion with the development of the joint itself, one may observe that no joint develops prior to the development of its own tendons, and that the development of the tendons themselves to a state in which they are able to function seems to be a prerequisite to the development of their respective joints.

Although direct proofs of the function of the muscle tissue of the locomotor apparatus in such earlier periods of intrauterine life are missing, one may concede with sufficient certainty that such function exists, from analogy with the activity of the myocardium in very young embryos.

Other important data which favor the mechanical theory of differentiation of joints are found in the study of the intermediate cartilage discs which precede the formation of the joint cavity. In the first phases of development the cells of this structure are large, vascular, and resemble those of the primitive mesenchyme. At a later period the intermediate disc becomes thinned out and its cells become differentiated by assuming an oblong or depressed shape, aligning themselves perpendicularly to the axis of the articulation.

All this indicates with probability that the muscle action must have a considerable influence upon the formation of the mesenchymatous tissue which forms the primitive intermediate disc, and it is hard to explain the formation of the cavity itself without calling upon muscle traction.

One must therefore conclude that while the formation of the articulations themselves in their very first development is subordinated to the phylogenetic laws, in the course of development, however, the functional modifications are influenced by mechanical factors, among which the function of the locomotor tissues surrounding the joints is most prominent.

The articulations develop from mesenchymatous tissue which represents the first buds of the growing extremities. The tissue forming the intermediate disc is lined by a connective tissue membrane which very early develops from the primitive blastema. Following the development of the articular capsule, the external and internal articular ligaments become differentiated.

Summary: The time of differentiation is not the same for all articulations, and those articulations precede in development which are normally in flexed position. The differentiation of the articulation itself is always preceded by the differentiation of its corresponding muscular apparatus. The formation of the joint cavity occurs almost simultaneously with the differentiation of the articular ends, and occurs by a process of differentiation of the embryonal connective tissue without the process of fatty degeneration or liquefaction. Certain free portions of the intermediate disc give rise to the later formation of synovial villi.

The cellular re-lining of the internal surfaces of the capsule is again a dif-

ferentiation of the connective tissue following mechanical influences. In general, the development of the articulations may be considered as occurring under phylogenetic laws only in the very first stages of differentiation. In the following stages, however, it is bound to the action of mechanical factors and to the function of the muscular apparatus surrounding the joint.—*A. Steindler, Iowa City, Ia.*

CIRCULATORY DISTURBANCES OF THE FEET. Emil S. Geist. *Minnesota Medicine*, February, 1922, page 98.

From a series of 500 consecutive cases of "foot complaint," there are presented 67 cases of circulatory disturbances. The 23 cases of venous stasis are mentioned in passing, but the 42 cases of disturbed circulation due to impaired arterial circulation are taken up in detail. Of these 42, 29 were male and 13 female; ages ranged mostly between 45 and 65; there were 27 Americans, 13 Jews, 1 German, and 1 Scandinavian.

Congenitally small blood-vessels, as well as various toxic agents, were held responsible in most cases. The excessive use of coffee, tobacco, and alcohol figured. Syphilis, diabetes, and exposure to cold are also mentioned. The patients complained of pain on use, pain at night, cramps on slight exertion, and especially that the wearing of braces increased the pain. The feet were often found to be somewhat cyanotic and at times edematous. In not one case could the pulsation in the dorsalis pedis artery be felt, and in more marked cases it was not possible to detect pulsation in the posterior tibial.

The following classification of arterial lesions of the foot is presented:

1. Congenitally small arteries. Under this heading the case of a girl, age 14, is reported.

2. Arterial spasm. Fourteen cases were grouped under this type. A case is reported of a male Jew, aged 58, who complained of cold feet and cramping after walking three or four blocks.

3. Arteriosclerosis of the feet. Twenty-three cases were grouped here. The symptoms are said to be more persistent and more severe than in arterial spasm. The calcareous arterial deposits are often shown by the roentgenogram.

4. Thromboangiitis obliterans. Two cases were placed in this group, and both are reported. The author thinks it possible that this is just the final stage of some of the cases of arterial spasm and arteriosclerosis. Jews are most frequently affected. Extreme thrombosis of the arteries of the foot and even the leg is present. Amputation is often necessary.

Under treatment there is mentioned: Sodium nitrite and potassium iodide, alternate hot and cold foot baths, woolen stockings, abstinence from coffee and tobacco, heliotherapy, and rest to the feet.—*H. T. Jones, Rochester, Minn.*

THE TREATMENT OF STRUCTURAL SCOLIOSIS AT THE MASSACHUSETTS GENERAL HOSPITAL. Armin Klein. *Jour. A.M.A.*, February 11, 1922.

Severe structural scoliosis (non-paralytic) is being treated on the assumption that it cannot, with our present knowledge of the subject, be cured. Over-

correction is not attempted; apparent symmetry and the absence of obvious deformity are aimed at. The patients are not kept in hospital more than three hours a week, but are allowed to continue their usual duties at school or work, and are encouraged to play whatever games they can, hampered by a plaster jacket weighing five to seven pounds.

After preliminary photographs, x-rays, and measurements, exercises are begun. No apparatus is used, and the exercises are repeated two or three times a day at home. The exercises mobilize the unused and tightened muscles and ligaments of the trunk, enabling the patient to localize his control over his respiratory muscles. It is on this force, carefully nurtured beforehand, that we rely for correction of the patient's asymmetry. After one to six months' exercises a corrective jacket is applied. This is done on an Abbott frame, the patient supine, the spine somewhat flexed, the shoulder girdle rotated towards the side of the convexity of the spinal curve, while the pelvic girdle is rotated in the opposite direction. In a right dorsal, left lumbar curve the shoulders are rotated towards the right (pushing forward the right rib prominence) and the pelvis in the opposite direction. This lessens the right rib prominence and at the same time tends to fill out the left-sided rib concavity. It is to be noted that with the pelvis fixed and the lumbar spine capable of but little rotation the rotative force both above and below is very largely concentrated on the dorsal area of the spine. The corrective jackets have windows over the concave areas and felt pads are applied every week to increase the correction. Casts are maintained until no longer efficacious, which usually occurs in a month, while repetition of casts goes on so long as improvement is shown. A removable cast is then made, with hinges behind and straps and buckles in front. Then for a few months exercises are given, to be followed by another series of permanent rotation jackets for still further correction. When the maximum of correction has been obtained from jackets in the rotated position other jackets are applied without rotation, by which the hump is attacked still further. These are followed by a brace worn over a period of years and accompanied by exercises, while Wolff's law of bone transformation may take effect.—*J. A. Nutter, Montreal.*

PSEUDO-PARAPLEGIA RESULTING FROM DOUBLE TABETIC ARTHROPATHY OF THE HIPS. André Léri and Lerond. *Bull. de la Soc. de Méd. des Hôpitaux*, November 25, 1921.

The authors report a case which had wrongly carried the diagnosis of paraplegia for twenty years. The paralytic symptoms were due to a tabetic arthropathy involving both hips, which had a very abrupt onset. The destruction of the head and neck of the femora was great, with ascent of the trochanters, thus destroying the leverage powers of the hip muscles. The knee jerks were absent, there was loss of deep muscle sense, and typical Argyll-Robertson pupils, but these had been overlooked on account of the apparent paralysis of the lower extremities.—*P. D. Wilson, Boston.*

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